October 1961

Agriculture

Volume 68 Number 7

Trafalgar Trees, near Amesbury, Wilts.

Published for the Ministry of Agriculture, Fisheries and Food
by Her Majesty's Stationery Office

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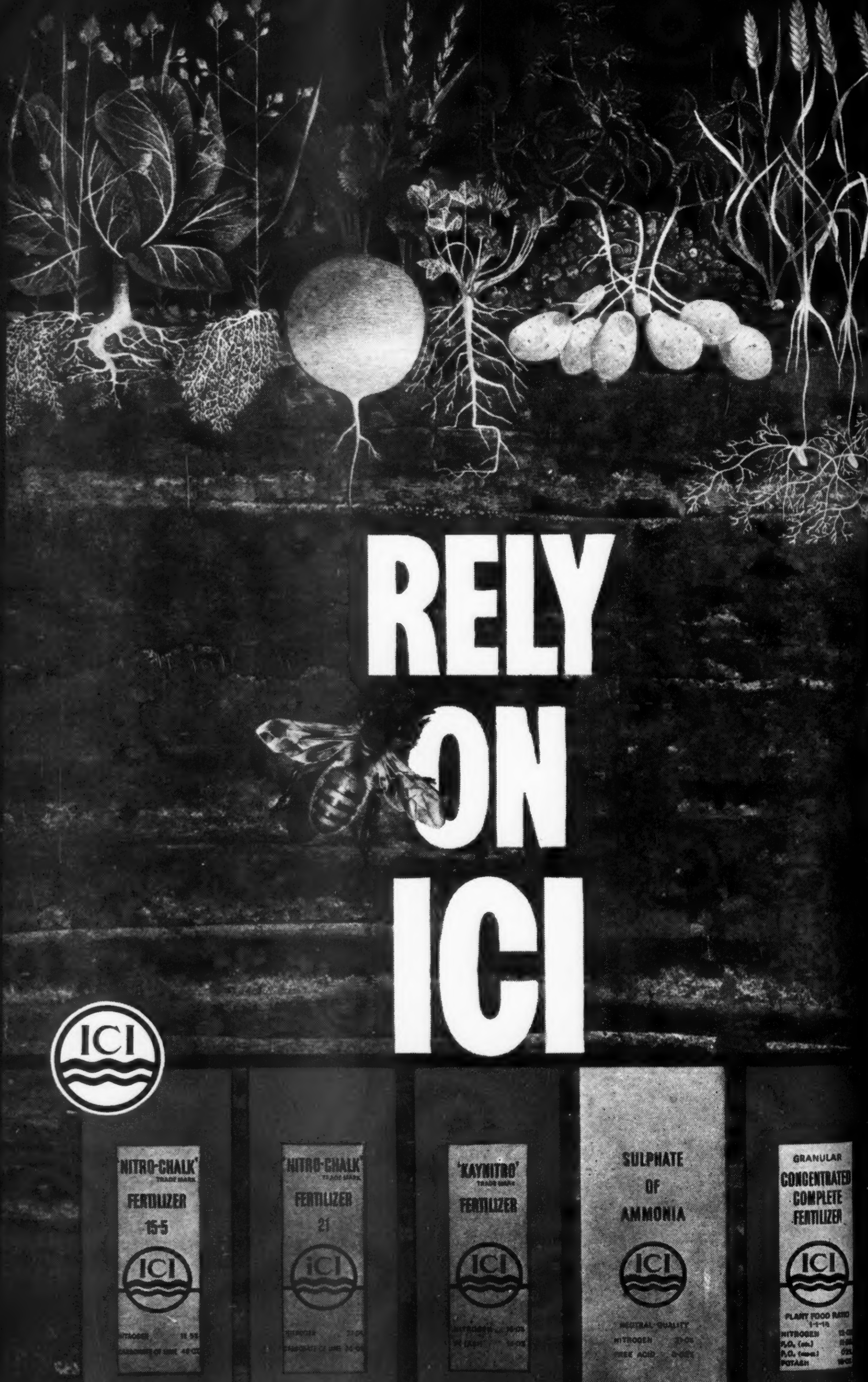
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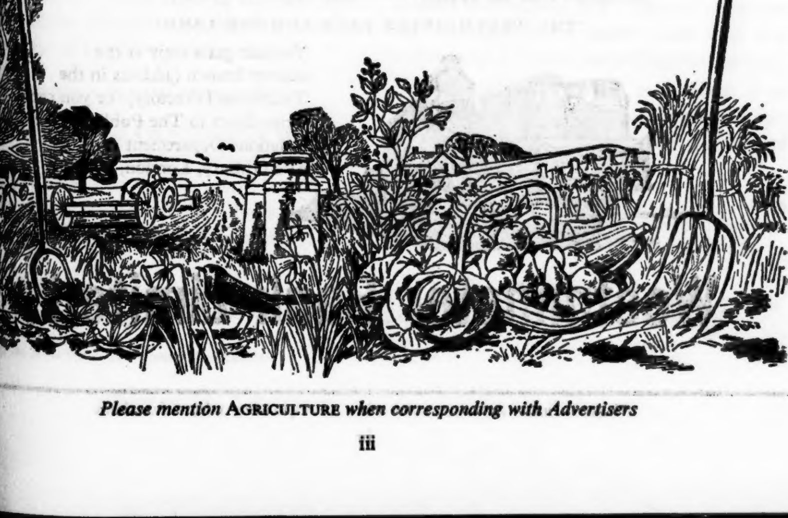

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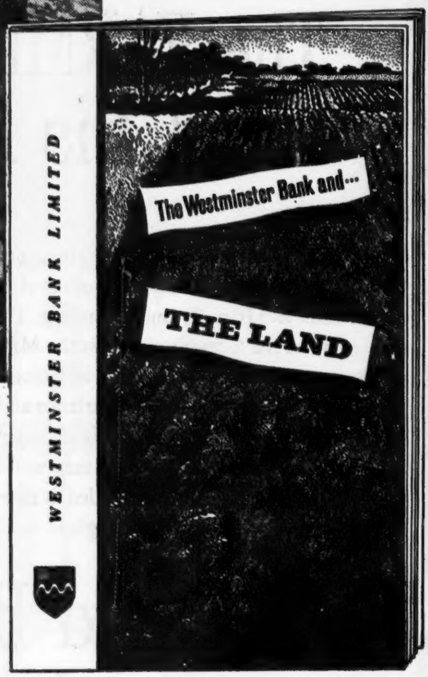

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Agriculture

Volume 68 Number 7 October 1961

EDITORIAL OFFICES
THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
WHITEHALL PLACE · LONDON S.W.1 · TRAFALGAR 7711

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Cover Photograph: Trafalgar Trees, near Amesbury, Wilts. (*see p. 389*)

Photo: Geoffrey N. Wright

The Revolution in Agriculture: 1

SIR WILLIAM SLATER, K.B.E., F.R.S.

By the kind permission of the British Association, we have pleasure in presenting the important and interesting paper which Sir William Slater read to this year's British Association meeting in Norwich.

AGRICULTURAL revolutions have their origins in economic and social causes; the Tudor enclosures from the desire for personal gain; the Hanoverian enclosures from the need to provide food for a rapidly growing industrial population; and that through which we are now passing from military and economic crises. But, although the forces which begin an agricultural revolution are economic and social, the impetus which carries it forward is provided by the new techniques brought into use to meet the new situation. When the forces which have started a revolution have either spent themselves, or have been contained by technical progress, the revolution continues until the pattern of agriculture has been so changed as to allow the new methods to be fully incorporated into farming practice. A new farming tradition then emerges, accepted by future generations of farmers as inevitably right, until another economic upheaval begins a new revolutionary era.

Roots in the 1914-18 war

The revolution through which we are now living had its roots in the First World War. This catastrophe struck a people, who for nearly half a century had relied on their industrial wealth to purchase cheap food from overseas, and who had relegated agriculture to an unimportant place in the national economy. Those amongst us, who are old enough, will remember the agricultural picture in late Victorian and Edwardian England—a land where permanent pasture, often of inferior quality, predominated; where plough and threshing machine were rusting in disuse, and where liquid milk production, based on imported feedingstuffs, formed by far the most important part of the industry. Except for a few bright spots, such as the production of vegetables, fruit and potatoes, farming was profitable only if the exhaustion of its capital resources was ignored. Rich men, deriving their wealth from industry, were content to invest money in country estates, expecting no return other than the social prestige attached to a country property. They were prepared to charge low rents to tenants, whose farming maintained the sporting and other amenities of the estate; if they had any farming interests these were most often in the breeding and showing of pedigree cattle.

The landlords, who had no source of income but their land, were gradually becoming bankrupt. They had been forced to reduce rents to enable their farmers to live, and had no funds available for the proper maintenance of their land and buildings. Farmers, even with the low prevailing rents, were surviving only by exhausting their land and restricting expenditure to the absolute minimum. The farm worker, although his wages had improved, was still amongst the lowest paid of all craftsmen. He remained in the townsman's mind as 'Hodge', the slow-moving, slow-thinking, cap-touching

peasant, who had not had the initiative or wit to move into the town, where good wages were to be had and where there was a chance of rising in the social scale, an opportunity denied to the farm worker in the rigid class structure of the countryside.

Such was the condition of farming, when in 1916-17 the submarine campaign forced on Britain the need to produce a large part of her food at home. The need was met by the widespread ploughing of permanent pastures and a return to arable cropping.

Farming became once more an important and profitable industry, but it did so by returning to the good farming of 1870, not by moving forward to new levels of technical efficiency, which would have enabled it after the war to compete with cheap food, produced extensively overseas. When prices broke in the early 'twenties, and the Corn Production (Repeal) Act removed both support for corn prices and abolished the Agricultural Wages Board, farming began to return rapidly to its pre-war state. It is not my purpose to discuss the vicissitudes of farming during the inter-war years, nor the shifts which were made by the formation of Marketing Boards and other economic means to save it from bankruptcy. What, however, was of great importance in carrying forward the present agricultural revolution was the impetus which the temporary prosperity and the subsequent collapse of farming gave to research and education. It was realized that, if British agriculture were to compete, it must rise to much higher levels of technical efficiency. This understanding of future needs was shown by the Government's attempt to meet the farmers' complaints over the Corn Production (Repeal) Act by the provision of a million pounds to be spent in five years on education and research.

The years following the war saw the establishment of many new research stations and the expansion of those already in being. Although during the depression of the late 'twenties and early 'thirties there seemed little opportunity for the results of this research to be applied, there remained a firm belief in the minds of those concerned with research that the time would again come when more food must be grown at home. This belief arose from the knowledge of the growing world population, the desire of the less developed countries for a higher standard of living and the exhaustion of the virgin lands from which much of our food came.

The output of work from the universities and research institutes in the twenty years between the wars, often carried out with few men and inadequate equipment, was both high in quality and large in quantity. Stapledon and his colleagues had demonstrated the value of ley farming with grasses and clovers bred for the purpose. The preservation of grass as silage and hay had been greatly improved. The work at Rothamsted had shown the way to better fertilizer practice, and Wallace at Long Ashton had demonstrated the importance of minor nutrients in plant growth. The control of many plant pests and diseases had been greatly improved, new varieties of cereals and potatoes had been bred which were capable of responding to higher fertilizer applications.

Research workers in genetics had shown that the art of animal breeding could in time, when the necessary quantitative records were available, become a science. Nutrition chemists had demonstrated the importance of the vitamin and mineral requirements of farm animals and the value of

scientifically balanced rations. Our knowledge of the physiology of reproduction and of lactation was greatly extended and the first steps were taken in the evolution of the technique of artificial insemination. Many of the diseases of farm animals were either prevented or controlled. Most important of all a vast store of fundamental knowledge was built up, which was available as a basis for the solution of applied problems as they arose.

As a result of these years of devoted work, when war again called for a great effort from our farmers, the increased output was not obtained as in the first war by a return to high arable production after the manner of the last century, but by developing and applying the new techniques which had been made available.

Threshold of a new era

The state of agriculture in 1939 was in many ways similar to that in 1914. Dairy cows, beef cattle and sheep were grazing large tracts of poor permanent pasture supplemented by the free use of imported concentrates; pig and poultry production depended on cheap imported materials; more tractors and other machines were in use, but the horse still provided much of the motive power; the level of fertilizer practice was far too low and the yields of crops little higher than in 1914. The farm worker was lowly paid—he received little more than half of the average wage in all industries—and the number of men on the land had fallen. The net annual output of agriculture in the United Kingdom was little more in the period 1935-39 than in that of 1911-13. Various Government measures in the 'thirties helped to maintain the acreage of cereals, but the total arable acreage declined.

The first step in increasing food production in 1939 was, as in 1916, to plough up the permanent pasture and return the land to arable farming. The approach to the task was not, however, by returning again to the farming of 1870; in 1939 the goal, from the outset, was to apply the knowledge which had been won by research and to move forward into a new era of farming based on a high level of technical efficiency. Moreover, Government and farmers alike looked on the raising of the level of agricultural production not as a war-time measure only, but as the pattern of farming in the future.

Whilst therefore steps were taken for the immediate increase of production, it was always in the minds of those responsible at all levels that the ultimate objective was a steadily rising standard of efficiency. No limit either in time or in extent was set for this programme; it was tacitly accepted that efficiency could continue to rise so long as scientists continued to produce the necessary knowledge to maintain the progress. It was expected that the growth would be initially rapid owing to the incentive provided by the war-time need for survival and the large volume of unused scientific results awaiting application. Equally, it was accepted that as the accumulated products of research were applied, the work of the scientists must be intensified, in order that new facts and ideas would be continuously available to maintain a steady rate of progress. This belief in the value of science led to the expansion of agricultural research, even during the worst days of the war, an expansion which was continued at a rapid pace when with peace the necessary men and materials were again available.

One question, which was never really answered and which still remains largely unanswered, was the real meaning of agricultural efficiency. During

the war the question was not asked; all that was required was the maximum yield regardless of cost. This remained virtually the sole criterion until rationing was no longer necessary; from then onwards new conflicting criteria began to be used. The farmers as a whole still thought of efficiency as maximum production at guaranteed prices based on subsidies. The Government, under pressure to accept growing imports of food at lower prices (often, it must be said, uneconomic prices) and faced with a large bill for subsidies on home-produced food, began to think of efficiency, not in terms of maximum production, but rather in the lowering of the cost of production and the limitation of the quantities of home-grown food, except where expansion was possible at competitive prices calling for no further support by subsidies. This difference of view colours the discussions during the review of agricultural prices each year, and on the solution which is finally reached will depend the future pattern of farming. The resolution of this conflict will rest not only on the extent to which the body of farmers as a whole are willing to apply the available technical advances to the full, but also whether they will accept the changes in the structure of the industry, which are essential for the achievement of this end.

In order to attempt an assessment of the technical advances and structural changes involved, it is necessary to study what had taken place between the beginning of the war and the late 'fifties, when the question of how far we should expand our home food production began to be seriously questioned.

Scientific basis of war-time farming

The war-time plan in 1939, as in 1916, involved the ploughing of permanent pasture, but the selection of the land for ploughing, the crop to be grown and the fertilizers to be used was no longer haphazard but scientifically based. Arrangements were made for the examination of fields scheduled for ploughing for freedom from pests, particularly wireworm, and for nutritional status. The farmer was then advised as to the first crop to take from newly broken land and the fertilizers essential for a reasonable yield. The available fertilizer supplies were rationed and directed to the places where they were most needed, and farmers were encouraged to use good seed of tested varieties and to take every precaution to protect their crops against pests and diseases. The shortage of labour was made up, not only by the means used in 1916, but also by supplying to the farmers all the tractors and implements, which could be imported or manufactured at home.

In the long-term plan, the newly broken land did not return to permanent pasture, but formed part of a ley-arable rotation, the plough being taken regularly round the farm. In this way the high arable acreage could be retained, whilst the leys by proper management provided, on the remaining acreage, more keep for stock than all the permanent pasture originally broken. At the same time the crops taken after a well managed ley were known to give higher yields per acre.

The results of these efforts during the war years were not, however, strikingly different from those of the First World War. The yields of cereals and potatoes showed no marked increase, the overall increase in production being roughly proportional to the additional acreage under cultivation. Milk production rose by roughly 5 per cent, but egg production was down by over

15 per cent, beef and veal by 7 per cent, mutton and lamb by more than a quarter and pig meat by over a half.

The explanation, for what at first may seem a disappointing result following the application of new scientific techniques, is not difficult. The farmers were only learning these new methods and doing so under most difficult conditions. Much of the land being ploughed had been badly neglected; it was often poorly drained, infested with weeds and denuded of plant nutrients. It frequently called for special fertilizer treatment to remedy marked deficiencies, deficiencies which were often recognized too late for effective action to be taken to save the crop. Although by 1946 the amount of phosphate used was more than twice that in pre-war years and nitrogen nearly three times as much, little more than one-third more potash was available, and this in many areas was the limiting factor in crop production.

Finally and most important of all, the time had not been reached when the leys sown on the arable land which had been cleaned and well fertilized through a rotation, came into production. Hence the output from the temporary and permanent grass had fallen, if not in proportion to the reduced acreage, sufficiently to cause a marked drop in the beef and mutton supplies. The dairy herd producing liquid milk had to be given the first share of the products of the grassland and of any grain and other concentrates available. Pigs and poultry which normally required grain and imported protein, had to make shift with limited supplies made up with waste materials.

New ideas, new skills

By the end of the war farmers had, however, seen the advantage of the new techniques and acquired some skill in their use. For the following decade the produce of their farms was required in maximum quantities at prices which were attractive to any farmer of reasonable competence, and highly profitable to the man with a well-organized farming business using all the modern techniques. There was, therefore, both economic advantage and pride in the newly-won skills, to encourage farmers to go ahead with the original plan of technical advancement.

The shortage of fertilizers was no longer a handicap; between 1946 and 1956 the amount of potash used was nearly doubled and the nitrogen increased by more than half. The phosphate increased for the first four years and then declined to the 1946 level as the need for heavy dressing fell, due to the residual value of the applications over the previous years. Moreover, during the post-war decade the farmer was provided with new technical aids which had not been at his disposal earlier. Perhaps the most important was the new range of selective herbicides which had been evolved as a result of fundamental studies of the nature of the substances responsible for plant growth. These materials have had a profound effect on farming practice. They have enabled the farmer to keep his fields clean with the minimum of cultivations; it is rare now to see a field of poppies or of charlock. At the same time they permit him to experiment with his crop rotation in ways which would have produced disastrous results when he had to depend on cultivation to keep his land free of weeds. The range of these herbicides is continually being expanded, giving the farmer ever greater freedom in his work and cleaner land for his crops. The chemical industry has also produced many new and powerful insecticides and fungicides which give added protection to

crops against pests and diseases. Here again the farmer, by their correct use, can be freed from many of the restrictions in his cropping which were previously essential if he were to obtain good yields.

The completion of this Paper will appear in next month's issue of *Agriculture*.

Infertility in Dairy Cattle

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The observations reported in this article are based on an investigation of infertility in 177 Friesian herds in Devon and Somerset.

SURVEYS of economic losses in dairy cattle pinpoint infertility as one of the major causes. The loss to the farmer can be attributed partly to the high proportion of culling caused by infertility, loss of milk yield due to delayed calving and the cost incurred in the treatment of infertility. In this country the farmer can get repeat inseminations without extra charge. This means that in cases of infertility, losses are also incurred by the artificial insemination centres due to repeat visits, which must ultimately be reflected in the basic charge to the farmer. It is very difficult to estimate the total losses attributed to infertility but in an infertility survey Munro[1] has quoted a figure of £18 m. for the annual loss to the country.

Accordingly a joint survey was initiated at Dartington Hall and Somerset Cattle Breeding Centres to investigate the incidence and causes of infertility in dairy herds using artificial insemination, the detailed results of which have been published elsewhere by Boyd and Reed.[2] The object was to keep a cross-section of the herds in the area under continual observation, rather than to investigate specific problem herds. In this way it was hoped to spot herd problems as they appeared and at the same time to investigate a number of factors likely to affect fertility. It was necessary to select the material to a certain extent. Only National Milk Recorded herds with over 15 animals were taken because it was essential to have firstly, reliable records and secondly, sufficient numbers to show any statistical differences that might occur between herds. One breed only, the British Friesian, was taken, in order to eliminate breed differences that might occur. Fertility was measured by the percent of first inseminations which terminated in pregnancy. At

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present an average level of about 60 per cent is achieved at artificial insemination centres in this country.

Brucella abortus

Only two infections were considered of sufficient importance for investigation. In the past *Br. abortus* infection, or contagious abortion as it is better known, used to be a scourge to the farmer. In a typical "abortion storm" the birth of a live calf was a comparative rarity on some farms and this was often followed by a period of infertility. However the advent of Strain 19 vaccination has completely changed the picture. In our investigation the presence of contagious abortion was determined by taking samples of milk and mucus from the vagina of each animal in the herd and subjecting them to agglutination tests. The incidence of *Br. abortus* infection in individual cows as judged by the milk ring test was under 5 per cent, although the proportion of herds with one or more positive reactors was as high as 55 per cent. The reason for this difference was that most herds had a small number of reactors. This test, which can be regarded as a substitute for the more usual blood test, requires careful interpretation because it can be affected by animals vaccinated with Strain 19 as adults and also by samples taken from animals in the first week after calving and in late pregnancy.

The incidence of positive reactors to the vaginal mucus tests, which is indicative of infection in the genital tract, was less than 1 per cent. It is not always appreciated that infection of the cow's udder with *Br. abortus* is quite common, and is of considerable importance both as a reservoir of infection in the herd and because of the public health danger of infecting those who consume raw milk. In such cases there are usually no signs of an "abortion storm" or discharges from the vagina. It was observed that some farmers did not take the opportunity of using Strain 19 regularly, although in fact some unknowingly had udder infection in their herds. The effect on fertility of positive reactions was also studied but was slight compared with the infertility due to other factors.

Incidence of Brucella abortus (contagious abortion) and Vibrio fetus infection

Infection	Test used	Number of animals tested	*Per cent* negative	*Per cent* positive
Br. abortus	Milk ring test	3,935	95·1	4·9
	Vaginal mucus agglutination test	2,670	99·1	0·9
V. fetus	Vaginal mucus agglutination test	2,610	97·3	2·7

Vibrio fetus

Vibrio fetus infection, a disease of the genital tract which is transmitted venereally, was assessed by taking vaginal mucus samples for the agglutination test. The incidence found was very small, being under 4 per cent, and the effect on fertility was negligible.

Both Brucella and Vibrio infections cause abortions, and although the incidence of abortions was higher in positive animals than in negative, it should be pointed out that the majority could not be attributed to these infections.

After an initial expansion which was very rapid, artificial insemination centres have consolidated their progress, and variations in conception rate are now limited. With the appearance of proven bulls in recent years, a demand for nominated service has arisen. In order to satisfy this demand cattle breeding centres have had to use semen more than one day old, and also deep frozen semen, because it is the normal practice to collect from a bull only once a week. In this investigation, as the age of liquid semen increased the conception rate deteriorated from 65 per cent for semen used on the day of collection to 46 per cent for that used more than three days after collection. A similar effect was seen with deep frozen semen, the conception rate also being 46 per cent.

Some farmers, who have experienced trouble in the past in getting animals in calf, with subsequent loss of time, often have them inseminated earlier than usual with the idea that if they do return to insemination, they can be done again without overall loss of time. The results in this survey confirmed that insemination within 60 days of calving lowers fertility. For instance animals inseminated before 40 days after calving had a conception rate of only 39 per cent, compared with 65 per cent for those inseminated over 90 days after calving. When an animal returns to insemination it has been shown that only 35 per cent do so within 21 days. Hence more time can be lost in animals inseminated early and returning than in animals inseminated at about 60 days after calving, which are more likely to hold to insemination.

It has been shown that a calving interval of less than twelve months lowers milk yield, and therefore those animals which become pregnant too soon after calving produce less milk. For this reason it is advisable to wait at least 60 days after calving before inseminating an animal.

This survey also confirmed that the age of the animal is not unimportant in its influence on fertility. The conception rate appears to reach a peak in those animals that have had two calves, being only moderate in maiden heifers. It is possible that some of this may be attributed to the difficulty in recognizing exactly when a heifer is on heat, particularly when she is wintered out and only seen perhaps once a day at feeding time. After the second calf, conception rate declines progressively from 67 per cent to below 50 per cent for animals with eight calves or more. Factors such as these can assume greater importance when the average age of the herd is high.

Two other factors influencing fertility over which the farmer has little or no control are the occurrence of abortions or twins. It was found that fertility was lower in the breeding period following the birth of twins or an abortion. It is possible that the conception rate is lower because these animals are inseminated before sufficient time is allowed for them to recover. Although the occurrence of abortions did not vary with age of the animal, the incidence of twin births did increase with age.

When working with fertility problems it is clear that in some herds with low fertility some factor exists which is common to the whole herd. The herds in this investigation were examined with this aspect in mind, particularly with regard to the level of farming intensity. Various factors such as high milk production have been suspected as a cause of infertility, but results obtained by previous investigations have been conflicting. In this survey its effect was assessed by noting the actual gallonage produced on the farm in relation to the number of milking cows in the herd and also the

acreage of grass available. This did not reveal any connection between fertility and milk production at either centre. During the last war and in the years since, farmers have been exhorted to plough up old pastures and produce more food, with the result that ley farming has been greatly developed. It was felt that with increased grazing capacities and different sward compositions there might be some adverse influence on fertility. This was examined by relating herd fertility with the percentage of leys on the farm up to 3 years, up to 5 years and the percentage of permanent pasture over 7 years, but again no relation could be found at either centre. Farming intensity was also calculated by the density of grazing, which was measured by the number of animals per 100 acres of grass, but no effect on fertility was observed.

Effect of kale on conception rates

One factor sometimes blamed for low fertility, and for which our survey produced evidence, indicating that it might cause low conception rates, was the feeding of large quantities of kale. The effect of this particular foodstuff on an animal is rather hard to assess, since on many farms in the south-west of England it is strip-grazed to the cows and therefore the quantity consumed is unknown.

Nearly all the farms in Somerset, and most of those in South Devon, were devoted almost entirely to milk production and were producing feedingstuffs for the herd, so it was decided to assess kale by the acreage grown as a percentage of the total farm acreage. When the amount of kale grown was below 9 per cent, there was no effect on fertility but above this figure fertility became progressively lower. This effect occurred independently at both centres. On closer examination it was observed that some other factors, such as the method of feeding kale to the cows, were related to heavy kale consumption and may have played a part in the fertility changes. In fact the relationship between kale and fertility requires considerably more investigation before any definite conclusions can be drawn.

The effect of these factors independently on herd fertility is usually of minor importance, but if two or three of them occur in combination then a serious infertility effect can easily be produced. As an extreme example of this it was noted that when cows which had had more than six calves were inseminated with deep frozen semen within 60 days of calving, a conception rate as low as 22 per cent was obtained. In such cases good improvements can be obtained simply by using nominated services more judiciously and avoiding a calving service interval under two months. At the other end of the scale, younger cows inseminated with fresh semen more than 60 days after calving had a conception rate of 70 per cent.

It is clear that some of the infertility-causing factors which have been described in this article are not under the control of the farmer. It was observed that there was little likelihood of infertility problems in herds in which nearly all inseminations were carried out under optimum conditions as described above. The fact that the reason for the return to first inseminations is understood in about only 25 per cent of cases makes it clear that most infertility problems are due to factors which have not been clearly defined. Statistical corrections were made for all the known factors so that a clearer picture of the residual infertility could be obtained. This revealed that

infertility in the worst herds was due to a combination of factors, some of them known and some of them unknown. There is therefore no easy remedy for fertility problems, and a lot of research work is still needed to increase our knowledge of the subject.

The authors are indebted to the members of the Private Centres Group Infertility Committee, which initiated and supported this investigation; to the Dartington Hall and Somerset Cattle Breeding Centres for providing facilities; to the Agricultural Research Council for financing the investigation, and to all other persons and bodies without whose co-operation the work would not have been possible.

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Better Field Work in Silage-making

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Taking another look at the job may often result in the saving of time, labour and money, as is shown by the three examples of field work which Mr. Brayshaw gives in this article.

IT is not sufficient simply to buy the most efficient and economic equipment. When bought it must also be utilized efficiently. Frequently it is not. All too often supervision is considered adequate if the work done is of satisfactory quality, if enough effort is put into it and machines are run at suitable speeds. Consequently the men may work hard, machines may be worn out all too quickly, but sometimes far too little is done. This is often the case when men are working as a team, as for example in silage-making.

Depending on the distance between the field and the clamp, a man with a tractor and rear-mounted buck-rake should make up to 2½ tons of silage an hour. Similarly, one man, or several working as a well organized team, should make up to 2½ tons per man-hour with a small forage harvester. When the field and clamp are no more than three hundred yards apart, the potential efficiency of a buck-rake is as great as or greater than that of a small harvester, however well the men using it may be organized. Where, however, the distance between the two is greater, forage harvesting offers the more efficient method because larger loads can be taken to the clamp in a trailer.

There is no easy solution which enables labour to be used more efficiently. Often its productivity is low not because the work is badly organized, but because many farms still lack suitable equipment or are short of workers with sufficient training and skill to operate modern machines efficiently. Thus, of a number of men using a buck-rake we found that a few handled it efficiently, but in most cases they lacked the skill to do this job really well.

First example

One case demonstrated the importance of having good equipment and using it correctly. Two tractors, a small forage harvester and one trailer were available. The field and clamp were 270 yards apart, and, if suitably equipped, one man should have made two tons of silage an hour without too much difficulty. On this farm two men made less than this in an hour partly because the trailer was unsuitable, and partly because in the way they were organized, two men did not comprise a suitable team. Some labour could easily have been saved by letting one man do the job by himself. Alternatively less time would have been needed if the other tractor had been used, and the second man had fetched the grass from the field and helped with the hitching and unhitching. Instead, much of his time was spent waiting for the next load of grass to arrive at the clamp. If, in addition, the trailer had been adapted to carry a larger load, or better still, exchanged for a suitable tipping trailer, labour productivity could have been more than doubled.

Second example

On another dairy farm the equipment for making silage consists of a forage harvester with a 58-inch cut, three tipping trailers each capable of holding about 28 cwt of grass, and two buck-rakes. A 50-horsepower tractor is available for pulling the harvester, and there are two smaller tractors for carting grass to the silage clamp.

Last year a three-man team was employed on making silage. One man operated the harvester, and two men carted grass to the steading, tipping it in front and slightly to one side of the end of the silo. In the middle of the afternoon cutting and carting stopped and one man then buck-raked the cut grass on to the silo whilst a second spread each load. This was a fairly satisfactory way of organizing the work. After allowing time for tractor maintenance, for starting and stopping both in the morning and in the afternoon, and for fitting and removing the buck-rake, the three men were able to cut and clamp rather more than 4 acres a day with an 8-ton crop.

But the farmer rather doubted whether this was the best possible organization. Depending upon which field was being cut, grass had to be carted from 200 to 1,600 yards to the clamp, and although all three men in the team were fairly fully employed when the haul was a long one, the two men carting grass had to wait about for each load when the haul was a short one. This year, therefore, the farmer has had two men making silage and, as will be seen from the tables on page 352, this has proved to be a better arrangement.

Whereas last year three men could cut and clamp 4·2 acres a day, two men using the same methods have this year cut and clamped from 3·1 to 4·2 acres a day, depending on the distance between field and clamp. However, two

can make all the silage produced, and the amount cut per day is of less importance than the amount each man makes in a day.

Table 1

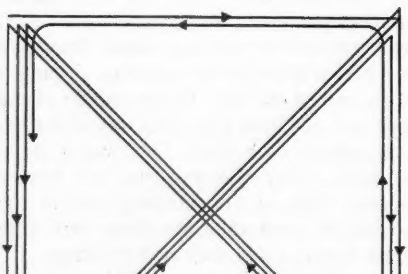
METHOD	ACRES PER DAY							
Distance from field to clamp (*yd*)	*200*	*400*	*600*	*800*	*1,000*	*1,200*	*1,400*	*1,600*
1. Using 3 men and 3 trailers as last year.	4·2	4·2	4·2	4·2	4·2	4·2	4·2	4·2
2. Using 2 men and 2 trailers this year.	4·2	4·2	4·2	4·2	3·9	3·6	3·2	3·1
3. Using 2 men but cutting with the tractor one gear higher, cutting out diagonals and then round and round, and with two men buck-raking on to the clamp and little or no spreading.	6·8	6·8	5·9	5·2	4·6	4·1	3·8	3·4
4. As Method 3, but using 3 men and 3 trailers	6·8	6·8	6·8	6·8	6·8	6·8	6·8	6·8

Table 2

METHOD	ACRES PER MAN PER DAY							
Distance from field to clamp (*yd*)	*200*	*400*	*600*	*800*	*1,000*	*1,200*	*1,400*	*1,600*
1.	1·40	1·40	1·40	1·40	1·40	1·40	1·40	1·40
2.	2·10	2·10	2·10	2·10	1·95	1·80	1·60	1·55
3.	3·40	3·40	2·95	2·60	2·30	2·05	1·90	1·70
4.	2·77	2·77	2·77	2·77	2·77	2·77	2·77	2·77

Last year each could cut and clamp only 1·4 acres a day, but this year each of the two men has been getting from 1·5 to 2·1 acres in a day.

Further aim at increased productivity



Seeking further improvement, the farmer concerned is now challenging the efficiency of the methods he has been employing and a number of changes are being considered.

Firstly, when cutting in fields which are not too irregular in shape he finds that there is a small but worthwhile saving to be obtained by cutting a headland round 7 or 8 acres, by cutting two or three times across the diagonals and then round and round instead of as previously up and down, and in lands. One way of doing this is shown in the figure opposite.

He also thinks it may be less necessary to spread each buck-rake load on the clamp than he had previously thought. For one thing his men have been wasting time trying and often failing to get very large loads on the buck-rake,

and it is clear that they would be better to aim at getting smaller loads. Again each load is already being very carefully positioned on the clamp, and it seems better to buck-rake the grass cut each day on to the clamp before doing that minimum amount of spreading which then still seems to be necessary. If so, and as his clamp is a wide one, both men will be able to buck-rake.

Finally, he has discussed the possibility of running the tractor pulling the harvester in one gear higher than his man has been using. The tractor driver did not think this was possible, pointing out that with a heavy crop or bad conditions, cutting would be less satisfactory, and that in any case at the higher speed it was not possible to blow grass to the back of the trailer, and therefore to get a full load. But having tried it, it seems likely that most of the time good work can be done with the tractor in the higher gear, without putting excessive strain on either tractor or harvester. Use of the lower gear seems really necessary only when travelling up the steepest parts of one or two fields, and when the crop is a very heavy one. The spout will be modified to blow the grass to the back of the trailer when travelling faster.

Further experience of the new methods is required before the farmer can be certain that each is entirely satisfactory, but it does seem that there is a good chance of increasing labour productivity by from 10 to 60 per cent, according to the distance between field and clamp. The increased daily outputs and the increased outputs per man that are expected are shown in the tables for different distances between field and clamp. They apply to cuts of about 8 tons per acre and it is intended to obtain similar figures for heavier crops. They will then be used to provide the basis for a bonus scheme in recognition of the increased productivity obtained.

To be fully successful, a man with a third tractor and trailer will be added to the team when the distance between field and clamp exceeds about 700 yards.

Third example

On a third farm other difficulties were met, but the scope for improvement was found to be even greater. The harvester was of the same make as that used on the previous farm, its width of cut was again 58 inches, but it was a new model with a higher potential output. Despite this, and although quite a large acreage was cut and clamped each day, output per man was low.

Two 25-cwt capacity tipping trailers were used. Each was pulled by a separate tractor, and filled whilst travelling alongside the harvester. At the clamp the trailers were backed on to a concrete apron and the grass tipped against a wall of railway sleepers. These were placed so as to enable the fourth member of the team to buck-rake the grass on to the clamp very easily.

When conditions were suitable a full eight hours a day were spent making silage, the men being paid extra to service their equipment outside normal working hours. With a 6-ton crop, each man cut and clamped 1·9 to 1·0 acres a day, depending upon the distance between field and clamp.

A number of improvements are possible. A first step must be to reduce to a minimum all unnecessary waiting. In many of the fields, although the trailers could be emptied and brought back in less time than it took to cut a full load of grass, the trailer drivers frequently misjudged the time they had in hand and kept the harvester driver waiting. Consequently, although

the trailer drivers had sometimes to wait 2 or 3 minutes before getting each load, the harvester was often kept waiting for as long as 2 minutes per load.

It is also important to get the men to appreciate the importance of obtaining full loads. These men did not, partly because one trailer was often waiting in the field before the other was anything like full, and partly perhaps because they received a bonus of one shilling for each load they got over six an hour.

With either a light or average crop, the use of a third tractor and trailer would make a greater output per day possible when grass was being brought from the fields farthest from the steading. Even so, it would be better to continue using two trailers, as with one extra in the team output per man is reduced.

Again, it would be better to cut a headland round an area providing a really good day's work (say 10-12 acres) and having cut out diagonals to cut round and round. It was found that working in lands some 10 per cent of the cutting time was spent cornering, as compared with about 3 per cent when cutting round and round. It would also be preferable to tow the trailers behind the harvester when filling them. Filled alongside, a greater acreage can be cut and clamped in a day, but four men instead of three are required, and output per man is much lower.

It is hoped that next year these changes can be made, and that each man will then be able to cut and clamp 3·2 acres a day. It is also hoped that greater productivity can be encouraged by using the performance data which has been obtained to provide the basis for a fairer and more efficient bonus scheme than the one used this year.

The Trade in Agricultural Seeds

S. T. SKELTON

In connection with the World Seed Campaign, this article, written by a seed merchant, gives an outline of the general pattern of the trade in the United Kingdom.

SPEAKING at the 1960 Crop Conference of the National Institute of Agricultural Botany at Cambridge, which opened this country's contribution to the World Seed Year, Professor H. G. Sanders said:

"It is very fortunate that we are served by an efficient and highly developed seed trade. I suppose some might regard the N.I.A.B. as a sort of watch dog in regard to the trade, but we all know that would be a misreading of the situation, since members of the trade are so prominent in the direction of the work of the N.I.A.B."

This tribute from Professor Sanders contains two main points which deserve early emphasis. The first is that the seed trade, through its competitive

nature, needs to be constantly developing its products and its methods to give an efficient service to the farmer. The second is that to carry out its functions efficiently, it must work in harmony with the official services—the N.A.A.S., the N.I.A.B., the Plant Breeding Stations and the Official Seed Testing Stations. The difficulty faced by the trade is that the harmonization of those two basic principles requires constant vigilance and, at times, concessions from both sides.

The World Seed Campaign, with its aim to promote the more widespread use of better quality seed, has the full backing of the trade. But the test, in the long run, is the economic gain by the farmer in using better seeds. Considerable progress has been made in expanding production of certified and field approved crops but the trade feels at times that more emphasis could be put on the value of better seeds by the official advisory services.

Organization of the seed trade

The seed trade in this country is carried out through two main sources. Firstly, there are the specialist seed firms, both wholesale and retail, who concentrate all or nearly all their resources on seeds. Secondly, there are the country's two thousand agricultural merchants, most of whom deal in seeds in addition to supplying feedingstuffs, fertilizers, agricultural chemicals and other farm supplies. A survey by the National Association of Corn and Agricultural Merchants three years ago showed that over 70 per cent of members were handling cereal seeds and 55 per cent supplied herbage seeds.

The specialist seed firms, while few in number, are household names in farming. Some, despite the lack of a royalty scheme to recompense them for their work, have carried out plant breeding for many years.

They, and the larger agricultural merchants with a considerable trade in seeds have run trial grounds at which new varieties are tested under local conditions. The initiative for bringing in the best Continental varieties for use in this country has come from the large seed houses, who work in close co-operation with the European Plant Breeders. In some cases their enthusiasm may have exceeded their discretion, but the report of the Committee on Transactions in Seeds on Plant Breeders' Rights clearly showed the reliance of this country on foreign bred varieties. The marked rise in average cereal yields since the war is due largely to the introduction of improved varieties from British and Continental breeders.

The total value of the trade in seeds is probably about £50 million a year, with cereals, seed potatoes and herbage seeds contributing the major share. Sales of cereal seeds to farmers are estimated at about 400,000 tons a year, seed potato sales at about 900,000 tons, while herbage seed sales average 35,000 tons annually. In addition, the seed trade has to supply seed for the sugar beet crop and for the wide range of other agricultural crops grown.

The major part of the seed used in the country is home produced. Considerable quantities of grass and clover seeds are imported, a very large proportion of which come from Commonwealth countries.

Like Caesar's Gaul, cereal seed can be divided into three classes. The first is the "pedigree" seed, which comes from the specialist seed houses, where it is grown and processed under strict supervision and sold at quality prices. The second is the field approved seed sold by the larger merchants.

Finally, there is the trade in "commercial seed" that is based on good quality stocks which are true to variety and which reach satisfactory standards of germination. Pedigree seed is the highest priced, with field approved seed earning a premium over commercial seed.

Cereal Field Approval Scheme

One of the most heartening aspects of the seed trade has been the trend, slow though it has been at times, towards quality. This can best be demonstrated with cereals and herbage seeds. The Cereal Field Approval Scheme is intended to provide English farmers with an officially sponsored grade of seed with the backing of an official body—the National Institute of Agricultural Botany. The scheme aims at providing quality seed which is true to type, free from disease and weeds.

The Field Approval Scheme was officially started in 1947 to co-ordinate all the regional inspection schemes set up during the war. The scheme is administered by the N.I.A.B., but the actual field inspection work is carried out by qualified inspectors employed by the participating firms or regional seed growers' organizations. Courses for inspectors are held each year at the N.I.A.B. and, before carrying out inspection work, they must qualify at the Cambridge course. Check inspections, on a proportion of the growing crops, are carried out by the N.I.A.B. Growing tests of field approved seeds are also carried out by the N.I.A.B. at Cambridge.

The scheme has expanded steadily since it started in 1947, when 38,000 acres were inspected. In recent years the acreage inspected has passed the 100,000 acre mark. In 1960, 211 seed merchants and 5 seed growers' organizations, using over 700 inspectors, participated in the scheme. Of the 162,000 acres inspected, seed merchants inspected 92 per cent and seed growers' organizations 8 per cent.

A summary of the scheme's operation in 1960 is given below:

Cereal Field Approval Scheme in 1960

	Acreage inspected	Acreage approved in field	Rejected in field	Approval deferred
Wheat	92,264	58,495	29,330	4,439
Barley	59,158	42,587	14,719	1,852
Oats	11,276	7,571	3,578	127
	162,698	108,653	47,627	6,418

Today the Cereal Field Approval Scheme accounts for about 30 per cent of cereal seed barley bought by the farmer, and with wheat about 40 per cent of farmers' purchases are field approved.

Herbage seeds

Very considerable but somewhat slower progress has been made with herbage seeds, but in these seeds the conditions for full certification are much stricter than in the production of field approved cereals.

Apart from Broad Red Clover the main production in herbage seeds is confined to the "S" strains, bred and developed by the Welsh Plant Breeding

Station, but there is a reasonable production of certified local strains through seed growers' organizations.

From an acreage of about 1,500 acres of "S" strains inspected in 1941, this year (1961) the inspected acreage is expected to reach a record of 44,000. Further, from the quality angle, whereas up to 1955 all production was on a field approved basis, today all is on the basis of full comprehensive certification into the bag and high standards of purity are necessary to achieve certification.

These results have been achieved by the fullest co-operation of the seed merchants with the N.I.A.B. through the national certification authorities and all production is on a contract basis between growers and merchants.

The total forecast for 1962 is 43,320 acres, which would be the second highest figure ever, next to that for 1961.

Among the separate varieties, those which will reach record figures in 1961 or 1962 are S.24 perennial ryegrass, S.22 Italian ryegrass, S.48 and S.50 timothy, S.53 and S.215 meadow fescue, S.59 red fescue and S.170 tall fescue. All cocksfoots will show a decline from the peak reached in 1959, although a large acreage will still remain, comprising a quarter of the total acreage in seed production of Aberystwyth strains.

Trade's help in maintaining quality

The seed trade has made a considerable investment in plant machinery and equipment, and in keeping up to date with new varieties and new techniques.

Seed cleaning is a complicated process, with modern machinery supplying the means to ensure that the final seed sample will meet stringent tests for analytical purity. This cleaning process can be a costly job, with in some cases losses of good seed as high as 30 per cent of the total weight of seed delivered.

In the interests of the farmer, treatment with seed dressings is now a recognized function of the trade in certain seeds. This is particularly the case with the cereals, where about 80 per cent of seeds sold are treated with powders or liquid dressing.

All the specialist seed houses, and many agricultural merchants with a considerable trade in seeds, operate licensed seed testing stations. Tests by private stations account annually for well over a half of all of the statutory tests.

Co-operation with other bodies

A high proportion of members of the trade are Fellows of the National Institute of Agricultural Botany and the relationship between the Institute and the trade is very close. Merchants are represented on the N.I.A.B. Council and on its specialist committees. Their co-operation is based on an appreciation by both sides of the other's point of view.

The Seed Trade is fully conscious of the debt that the vast majority owe to the plant breeders. It has expressed its full co-operation in implementing a system of royalty payments to the breeders, and is giving all help possible to the British Association of Plant Breeders, who are at present working out a

system for submission to the Ministry of Agriculture arising out of the favourable report of the Committee on Transactions in Seeds.

There is also close working liaison between the trade and the Ministry on the working of the Seeds Act and other measures aimed at providing the farmer with seed suitable for his requirements. The trade has co-operated with the Ministry in moves to improve seed quality and has accepted the need to keep seeds legislation in line with improved methods.

The report of the Committee on Transactions in Seeds described seed "as a living product whose care and control up to the point of sale to the farmer presents difficulties not often found to the same degree with other commodities and other trades". The seedsman is fully conscious of those difficulties. Fluctuations in supply and price, in quality and consumer demand are accepted as normal trade hazards. Last spring, to take one instance, the cereal seed trade had to meet an exceptional demand for spring varieties to replace the large acreage of winter wheat which could not be sown because of the miserable autumn and winter weather conditions. This service is accepted as natural, but it is the practical result of having in the country what Professor Sanders called "an efficient and highly developed seed trade".

Aspect and Time in Soil Formation

E. M. BRIDGES, M.Sc.
*Soil Survey of England and Wales**

THE opportunities provided by nature for man to study soil formation in progress from a known date are few. Dokuchaev and Akimtzev studied the soils found on the fortress ruins in Russia. There is Van Baren's study of soils formed on the ash from the eruption of Krakatoa, and Tamm's of the podzolization of the floor of the drained Lake Ragunda in Sweden. Except for Salisbury's account of the changes in the Southport dunes, however, few examples of soil formation over a known length of time have been recorded in England. This account reports some interesting information that came to light when the soils forming upon the areas disturbed by ironstone mining were studied in Northamptonshire.

The areas concerned are situated around the industrial town of Corby, on the dip-slope of the drift-covered Inferior Oolite Series. The sequence is made up of the Lower Estuarine and Lincolnshire Limestone, succeeded by the Upper Estuarine. These beds overlying the Northampton Sand Ironstone were removed, placed behind the excavators, and the iron ore dug out. As the working face moved successively forward, the original overburden was left behind in a series of parallel heaps, 15 to 20 feet from top to bottom, a

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state known as "hill and dale". The original soils were mostly formed upon the overlying boulder clay, but the material now left is a heterogeneous mixture of the strata that made up the overburden. From the point of view of soil formation, this mixture constitutes a fresh parent material exposed for a known length of time.

Most of the land mined for ironstone is restored after working, with the intention of returning it to agricultural use. However, in some areas where the overburden was thicker or the original soils very shallow, it was not possible for restoration to be carried out, and the hill and dale has been left. So far it has been found that the only practical use to which hill and dale could be put is growing trees, and the company working the quarries has afforested considerable areas with larch and other species. In this way the unsightly hill and dale is covered and also provides a supply of timber. The vegetation cover is relatively uniform, and can be considered to be the same for all sites, the only difference being the age of the trees. As far as climate is concerned, this is relatively comparable, for all the areas studied were less than three miles apart, and the range in altitude is between 350 and 400 feet above O.D.

Parent material, climate, relief, and vegetation are all very similar for all the areas, thus overcoming the usual difficulty of keeping the soil-forming factors constant, while one, in this case time, is changed. In this study the date of working is the point where soil formation is considered to begin. It proved convenient to study areas that were worked at successive intervals of ten years—about 1920, 1930 and 1940. In most instances afforestation took place shortly after mining operations finished. The following table gives the details of the areas studied:

Name	National Grid Reference	Date Worked	Date Planted
Gretton Tunnel No. 5	42/902,884	1918-23	1923
Stanion Lane No. 4	42/892,924	1918-20	1921-22
Deene No. 39	42/914,914	1928-33	1947-48
Stanion Lane No. 30	42/906,822	1939-42	1943-44
Brookfield No. 28	42/900,915	1936-41	1942-43

Soil sites

All the areas were worked so that the hill and dale had an approximate east to west trend, except for Stanion Lane No. 4 where the hills had a north-east to south-west trend. The original heaps settled so that now the inclination of the sides of the hills is between 27 and 33 degrees. During the settling process some of the larger blocks slipped into the dales, and a considerable quantity of finer material, mineral and organic, has been washed from the slopes into the dales, where it has been re-deposited in temporary pools.

The areas of hill and dale are markedly broken into soil sites with different aspects: hill top, south-facing, dale bottom, and north-facing. Because of the aspect the dales and the north-facing slopes are not warmed by the sun for much of the year. There is, therefore, much less evaporation, resulting in almost continual dampness. The soil sites are divided into those which shed water, and those which receive run-off water, an important contrast when considering the type of soil formation that will take place.

Vegetation

Natural regeneration soon begins, and on the areas worked and planted about 1940, the coarse tufty grass *Calamagrostis epigejos* is the dominant member of the ground flora. Willow-herb is also very prevalent, and on the north-facing slopes and in the dales, the surface is covered with moss, so that no bare patches exist. On the crest and south-facing slopes, moss is absent, and bare patches occur over about 25 per cent of the surface. There are scattered small bushes of alder, dog rose, and blackthorn.

There is less bare ground on the areas worked about 1930, but their floral composition was very similar to the areas worked ten years later.

On the oldest areas, those worked about 1920, the ground cover and canopy are complete. Several unidentified species of grass are present, as well as nettles, brambles and dog rose. *Calamagrostis epigejos* is notably rare or absent. Mosses are again common in the dales and on the north-facing slopes.

Twenty-year-old soils

At this stage of development, considerable differences can already be seen in soils forming upon different aspects. The larch trees provide only about 50 per cent canopy, and the ground cover of vegetation is incomplete, about 25 per cent bare ground remaining. On the hill top and south-facing slopes a moderate amount of incorporation of organic matter has darkened the surface 2 inches, and there is slight evidence of more strongly formed structural units in this horizon. Between 2 and 6 inches there is a horizon with very weak structure and frequent fragments of weathered rock. Below 6 inches there is little penetration of organic matter and roots other than woody tree roots (see 1. in diagram).

In the dales, because of the downslope migration of the finer material, soils of finer texture are found. On the surface there is a more complete ground cover by grass and moss than on the south-facing slope. Litter (L) and fermentation (F) horizons can be distinguished, but no humus (H) horizon. A weakly formed sub-angular blocky structure is typical, in which signs of gleying were found below 2 inches. Abrupt horizontal breaks were observed in some dale profiles, indicating that these silty clays were probably laid down in temporary pools.

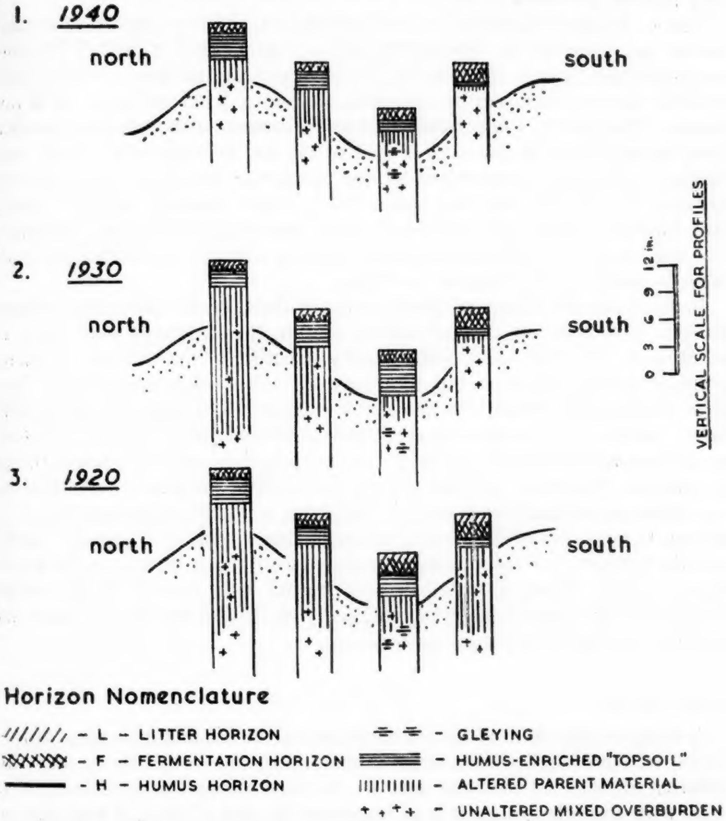
The north-facing slopes showed little progress in soil formation. A typical profile showed a mat of larch needles from 1 to 2 inches thick, with a covering of moss. Below the mat there is virtually no mixing with the mineral soil; the mat can usually be peeled off the surface revealing the relatively unweathered material beneath. Little incorporation of organic matter has occurred and the structure units are very weak.

All the profiles examined on the areas worked about 1940 were calcareous throughout, often with many weathering ooliths and fragments of limestone scattered through the profile of the soil.

Thirty-year-old soils

The ground cover of vegetation was complete, but owing to the lapse of time between working and planting this area, the canopy development by the

Soil Formation on Hill and Dale—Profile Characteristics



larch was not much different from the 50 per cent achieved on the 20-year-old areas. The same features apparent in the 20-year-old areas can be seen, but there is a perceptible increase in the strength of the structural units of the soil. Instead of the weakly formed beds of the 20-year-old soils, the term moderately well formed is more frequently used and the amount of incorporated organic matters appears to be greater (see Fig. 2. in diagram).

In the dales the mottling indicative of poor drainage was evident, and the soils were much moister than those on the adjacent hills. On the north-facing slopes slight incorporation of organic matter was apparent beneath a similar mat of larch needles covered with moss. Like the 20-year-old areas, all profiles showed a vigorous effervescence with 10 per cent hydrochloric acid.

Forty-year-old soils

On the areas worked about 1920, several differences can be seen from the 1930 and 1940 areas, notably in the vegetation and superficial soil horizons. The larch trees have grown to give almost complete canopy, even though

thinning has reduced their numbers, and the ground flora is more diversified with several species of grass.

The L, F, and H horizons are well developed, and the amount of organic matter incorporated into the mineral soil is greater (see 3, p. 361). With more complete humification the reaction of the superficial horizons becomes acid, and the humus form can be classified, following Kubiena, as a larch raw humus. The mineral soil beneath remains calcareous, although some decalcification had begun in the surface inch of the soil on these older areas, particularly where the proportions of non-calcareous Estuarine material were greater. On the hill top and south-facing slopes medium angular blocky structures have been well developed. Root penetration was good, and where this was combined with mechanically derived organic matter the structure was also improved in the lower horizons.

In the dales the effects of gleying were evident, giving olive-grey colours. In spite of greater amounts of organic matter, the structures were weak. In addition to the weak sub-angular blocky structure of the surface, shrinkage cracks could be seen extending to at least 12 inches below the surface. These were particularly obvious on the Stanion Lane No. 4 area, where the hills have a north-east to south-west trend and direct sunlight was able to penetrate to the bottom of the dale, causing more evaporation and more severe drying conditions. Where the hills are aligned east to west the direct warmth of the sun is unable to reach the bottom of the dales, especially when the trees have grown. In common with the other areas, the incorporation of organic matter and the formation of pedological structures were much slower on the north-facing slopes. Penetration of organic matter was mainly along natural fractures in the parent material, and few structural features were seen that could be ascribed to pedogenic processes.

Conclusion

A visual examination of the soils forming on the hill and dale areas showed that there were marked differences in the rate of soil formation on sites with different aspects but the same age. At the stage of development reached by these soils the role of aspect is as important as that of time, if not more so. Incorporation of organic matter is proceeding, and is giving the soils an increasing stability of structure with the passage of time. The development of the larch canopy with its litter supply is important, for only when this is complete, and almost continually moist conditions prevail, do the pH values of the superficial horizons begin to fall to pH 4·5 or 5. The frequent drying out of the soil before the development of canopy shade seems to have held back this process of lowering the pH values. On the hills imperfectly to freely drained calcareous soils are developing, but in the dales soils are forming with many affinities to gley soils. Little progress in soil formation has occurred upon the north-facing slopes. Classification of these very immature soils is, however, very tentative.

These observations were made during an investigation into soil formation on hill and dale for the Land Restoration Committee of the Ministry of Agriculture. The author records his thanks for permission to publish material contained in a report submitted to the Committee. The advice and help of Drs. Muir and Osmond is gratefully acknowledged, as is the permission granted by Messrs. Stewarts and Lloyds Minerals Ltd. for access to the woodlands upon their estates.

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Since the list published in the September, 1961, issue of AGRICULTURE (p. 332), the following publications have been issued.

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Machine Milking in Parlours and Portable Bails

P. A. CLOUGH, B.Sc. and C. C. THIEL, B.Sc., Ph.D.
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Various aspects of machine milking in parlours and bails are being covered by the exhibits of the Milk Production Advisory Group of the National Agricultural Advisory Service, the Milk Service, and the National Institute for Research in Dairying on the stand of the Ministry of Agriculture, Fisheries and Food at the Royal Dairy Show.

THE N.I.R.D. exhibit at this year's Dairy Show consists of a 6-unit pipeline milking installation and a 2-unit direct-to-can installation. The main emphasis is on the design and layout of components to facilitate circulation cleaning of pipeline machines and immersion cleaning of direct-to-can equipment.

Direct-to-can and pipeline machines have long been established as the two types most suited to milking parlours, but it is only in the last few years that serious efforts have been made to improve the design of components and develop labour-saving methods of cleaning these machines.

Direct-to-can milking and immersion cleaning

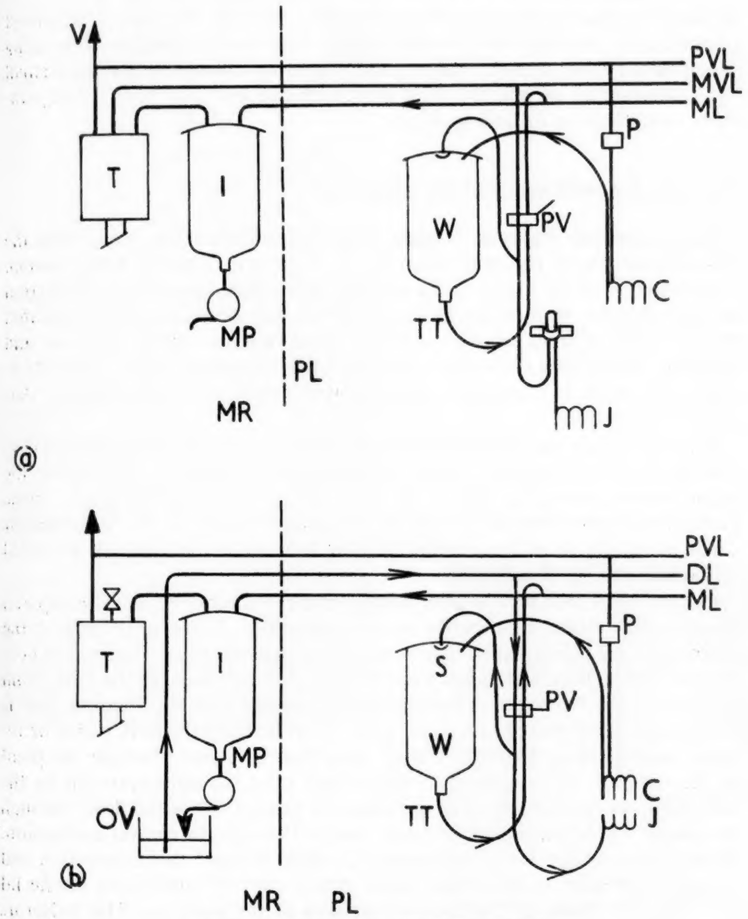
Direct-to-can milking is particularly applicable to smaller herds managed and milked by one person. Work done at the N.I.R.D. in 1955 showed that stainless steel can lids and clusters, and the associated rubber ware, could be effectively cleaned by immersion for the whole of the period between milkings in a 3 per cent solution of caustic soda. Immediately after milking the equipment is rinsed, dismantled and placed in an open metal basket in such a way that air-locking is prevented when the basket is lowered into a bin containing the chemical solution. Before milking, the basket is removed from the bin, the components are rinsed in a weak solution of sodium hypochlorite, and assembled ready for use. For three sets of equipment in a basket the total time spent by the operator for preparation and cleaning should not exceed 20 minutes per day.

Direct-to-can milking with immersion cleaning is the simplest and cheapest milking system for parlours where provision for yield recording is required. Immersion cleaning is described in detail in Advisory Leaflet 496.

Pipeline milking and circulation cleaning

Interest in pipeline milking has been stimulated by the introduction of bulk collection of milk from farms, the increase in the number of bigger herds which require two milkers, the popularity of two-level milking parlours, and the reports of successful use of circulation cleaning in other countries.

The milking machine installation developed at the N.I.R.D. has overcome the deficiencies of previous layouts. The usual components have been rearranged in such a way that little time is spent preparing for cleaning or



CIRCUITS FOR MILKING AND FOR CLEANING

(a) PLANT SET FOR MILKING

V—to vacuum pump; T—self-draining trap; I—interceptor vessel;
MP—milk pump; PVL—pulsator vacuum line; MVL—milking vacuum line;
ML—milk line; P—pulsator; W—weigh jars;
PV—pinch valve; TT—transfer tube; C—cluster;
J—jetter; MR—milk room; PL—milking parlour

When milking, the pinch valve is set so that the transfer tube is closed and the vacuum tube open. Reversal of the pinch valve lever opens the transfer tube and closes the vacuum tube, air being admitted through the cluster to discharge the milk into the milk line.

(b) PLANT SET FOR CIRCULATION CLEANING

OV—small open vessel; PVL—pulsator vacuum line; TT—transfer tube;
ML—milk line; S—spreader; C—Cluster;
J—jetter; PV—pinch valve; DL—detergent line (milking vacuum line during milking)

Liquid is drawn around the plant by vacuum and returned to atmospheric pressure by the milk pump.

milking, the clusters are cleaned in place, flow through the units is equalized automatically, and the rate of milk transfer from the jars increased by using ¾-inch-bore rubber transfer tubes. Liquid hold-up during circulation is small and consequently an effective heat treatment can be given with a comparatively small volume of boiling water.

Circuits for milking and for cleaning

Three pipelines are used—a glass milk line, a similar line connecting the self-draining trap in the milk room to the weigh jars, thus applying vacuum to the interior of the liners, and a separate galvanized iron vacuum line from the self-draining trap to the pulsators. With this arrangement of pipelines the pulsation system remains isolated from liquids during milking and cleaning. Although a third line is involved the advantage is that little alteration to the plant is required in changing from milking to cleaning (see diagram on page 365).

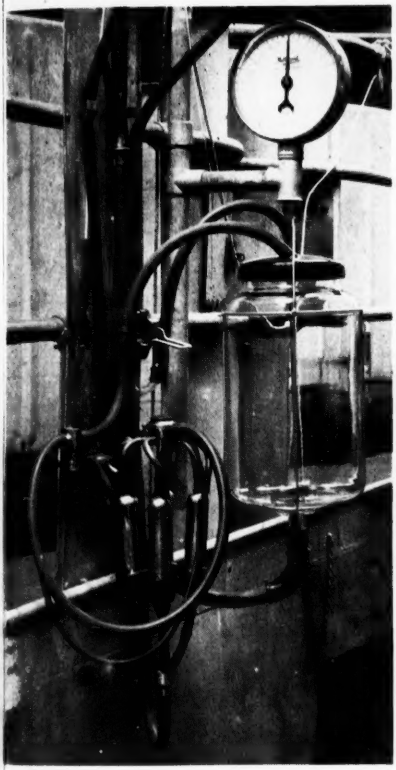
During milking the rubber tube to the jetter is sealed by a fixed metal clip. The operation of the unit is controlled by a rigidly mounted pinch valve, the rubber tubes passing through it being closed by cam-operated pinch plates. To discharge milk from the weigh jar the vacuum supply to the lid of the jar is cut off at the same time as the transfer tube is opened, and air admitted to the jar through the cluster.

At the end of milking the jetter supply tube is withdrawn from the clip and the teat cups (after the removal of any external soil) are connected to the jetter cups (see photographs opposite). The pinch valve is moved to the neutral position so that both tubes passing through it are open. In the milk room the connection from the self-draining trap to the milking vacuum line is broken and reconnected to a small open vessel beneath the milk pump or releaser outlet. Liquid from the trough may then be drawn through the plant by the vacuum, and returned to the trough from the interceptor jar by the milk pump or releaser. At each milking unit part of the liquid flows through the cluster to the jar and part enters the jar through the central connection. A metal disc, about 1 inch in diameter, is fixed beneath this connection and acts as a spreader to distribute liquid evenly over the underside of the lid and over the whole of the internal surfaces of the glass jar. The pulsators operate throughout the cleaning cycle.

Transfer tubes

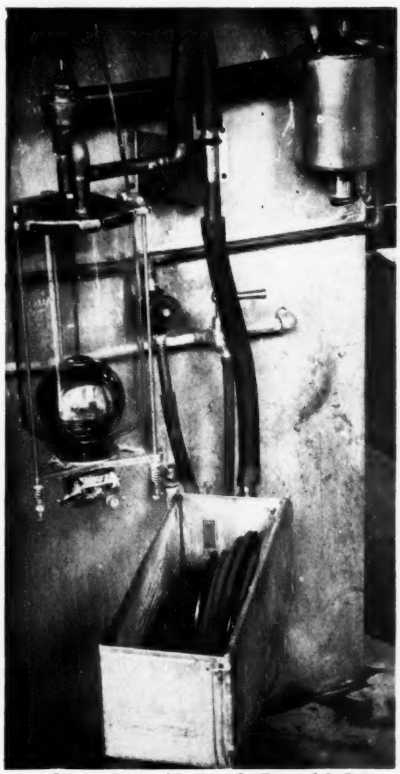
The time taken to withdraw 3 gallons of milk from a weigh jar was found to be about 45 seconds with a ½-inch-bore transfer tube, about 24 seconds with a ⅝-inch tube and about 15 seconds with a ¾-inch-bore tube, the plant operating at a vacuum of 15 inches of mercury. To avoid delays in the milking routine the bore of the transfer tube should not be less than ¾ inch. Tubes in natural rubber as heavy as this will, however, affect the accuracy of weighing unless the operator takes care to avoid disturbing them in any way during the course of a milking. A logical development would be the use of rigidly mounted jars calibrated for volume measurement as shown in the exhibit.

Pipeline Milking Equipment



Left: A milking unit set for circulation cleaning

ight: The self-draining trap: releaser and trough ontaining can lids and loop tubes used in series can filling.



Photos: *National Institute for Research in Dairying*

Shelter-belts in Glen Nochty, Aberdeenshire, planned to check "canalized" winds which follow the course of the valley.

Photos: *Forestry Commissi*

An old Scots pine belt on the sandy Norfolk Brecklands. Rather narrow, it has become too open at the base.

An effective mixed belt of Corsican pine and beech on the Hampshire Downs; the hedge closes the gap at the foot.

Photos: *Forestry Commission*

Young belts planted to shelter a farmstead, 1,000 ft. up, in a valley in Cardiganshire. Japanese larch (to left of farmhouse) have started growth ahead of Sitka spruce.

Care of a Working Collie (Article on pp. 379–80)

Photos: *W. Fife*

(Two of Mr. Fife's working collies)

(*Top*) "Trim", a bitch, (No. 9045 in the Stud Book), whose sire won the International one year and the Doubles the next. The good conformation which Mr. Fife describes is clearly seen.

(*Below*) "Toss", a ten weeks-old-puppy.

The cleaning cycle

The cleaning cycle consists of drawing cold water through the plant until milk residues have been removed, then circulating warm detergent hypochlorite solution for 3 minutes, and finally flushing with cold water. The total time for cleaning is not more than 7-8 minutes, except when a heat treatment is given after the warm detergent hypochlorite wash instead of the cold water rinse. About 1 gallon of liquid is required for each milking unit and for the warm detergent hypochlorite wash four ounces of the detergent (80 per cent soda ash, 20 per cent hexametaphosphate) are dissolved in six gallons of water at a temperature of 145°F. By the end of washing the temperature of the liquid is about 110°F. After the final rinse the plant is drained by detaching the clusters from the jetters and the transfer tubes from the bottom spigots of the jars.

Because of the large number of parallel flow paths which the solutions take in travelling from the detergent line to the milk line (12 for a 6-unit plant), uneven flow through the individual units is likely to occur. This can be reduced by placing restricting orifices at the side branches of the detergent line, their total cross-sectional area being about equal to that of the detergent line, but liquid is still likely to accumulate in individual jars. Admission of air at the jetters largely prevents this, increases the volume of circulating fluid, and so increases velocities.

Heat disinfection

Because of low liquid hold-up it is possible to use hot water to achieve bactericidal temperatures throughout the plant. Boiling or near-boiling water is run direct from an elevated, electrically heated wash-boiler into the trough, care being taken to avoid drawing in air as the water is sucked into the plant. The first water returning to the pump is comparatively cool, as much of its heat has been given up to the plant. After about 6 gallons of water have been discharged to waste, the temperature at the pump rises to about 170°F. At this time the discharge from the pump is directed into the trough and a further 6 gallons of boiling water circulated to maintain temperatures of 170-175°F for 2 minutes.

Milk quality and plant rinses

In experiments using two identical 3-unit pipeline machines, milk of satisfactory keeping quality (as measured by clot-on-boiling and methylene blue dye reduction tests) has been produced with and without regular heat treatment. However, bacteriological rinse counts of the plants were not always satisfactory. With no heat treatment rinse counts regularly exceeded accepted standards: with twice-daily heat treatment the rinse counts were always low. Once-a-week heat treatment produced satisfactory counts immediately afterwards, but the counts were usually high by the time the next heat treatment was due.

Milk collection and cooling

Where possible, milk is pumped directly from the milk line into a refrigerated bulk tank situated in the milk room. On most farms, however,

milk from a pipeline machine is released or pumped into a D-pan and run over a surface cooler into one or more cans standing at lorry platform height. The cost of cooling if mains water is used with this system is likely to be about a farthing per gallon, since only 3-4 gallons of water will be required to cool 1 gallon of milk. The D-pan and surface cooler require hand cleaning and some supervision is necessary in the milk room during milking.

Alternatively, milk may be drawn from the milk line into a series of cans with lids and loop tubes, the whole assembly being under vacuum.

During washing, liquid pumped or released from the plant is discharged over the lids and loop tubes lying in a small trough from which liquid is drawn back into the plant (see page i of art inset). The most effective method of cooling during milking is by means of a sparge ring, with a cold water flow-rate of 100 gallons per hour, on each of the first three cans in series. A sparge ring is fitted to an additional can for every 20 gallons of milk in excess of 60 gallons per hour.

Air agitation of the milk is effected by the provision of an air admission hole of $\frac{1}{32}$-inch diameter in the milk line and the use of an inlet tube extending to within six inches of the bottom of each can. At the end of milking, milk in the two cans nearest the parlour will not be cooled sufficiently, and a further period of about 15 minutes with air agitation or 60 minutes without agitation is required to complete the cooling of the milk in these two cans. In most instances a further 15 minutes of air agitation can be arranged by the milker disposing of the cows, cleaning down the parlour and preparing the equipment in the parlour for cleaning before disturbing the series of cans in the milk room.

Since some 6-8 gallons of water are required to cool each gallon of milk the cost will be greater than with a surface cooler. However, with cans in series no supervision is required in the milk room during milking and all but one can will be filled to the correct level. The can lids and loop tubes are included in the circulation cleaning system and no hand scrubbing is necessary.

★ NEXT MONTH ★

Some articles of outstanding interest

CONTROL OF POTATO VIRUSES BY INSECTICIDES *by L. Broadbent*

FIGHT AGAINST BRACKEN *by W. W. Fletcher and R. C. Kirkwood*

FUTURE OF THE TURKEY INDUSTRY *by R. Feltwell*

WINTER FEEDING OF DAIRY COWS *by W. Holmes*

Maintenance of Diesel Tractors on Small Farms

G. F. SHATTOCK, N.D.AGR.E., A.M.I.A.E.

National Agricultural Advisory Service, Somerset

Why, the author asks, is less pride shown by the tractor driver in his tractor than by the old carter in his horse? Neglect of adequate and regular servicing simply means storing up trouble, with consequent delays and expense.

FARMERS are frequently being criticized for the low standard of maintenance given to their machinery—tractors in particular. Many efforts have been made to encourage them by the provision of lubrication charts, log-books, etc., to take a greater interest in this matter. The fact must be squarely faced that tractor maintenance is an unattractive chore to most farmers. As long as neglect does not become immediately apparent through poor starting, excessive tyre wear, or even engine failure, the tendency is to attend only to the basic necessities of topping up with fuel, oil and water. The slow deterioration effect leading to loss of power does not become apparent until you actually need it for the forage harvester or rotary cultivator, and the uneven wear on brakes may not become noticeable until you start travelling sideways down a steep hill with a load behind.

Pride in the machine

One wonders why the pride which one associates with the carter and his horses is not so apparent in the tractor driver and his tractor. Possibly the horse was able to demonstrate its displeasure in a more obvious way by stamping its feet and kicking at the walls of the stable. But one of the main reasons for the difference must be that each man was given the responsibility of looking after his own horses, and keen competition was fostered. That this system works with tractors, too, is often obvious, and I think it fair to say that on the larger farms where one man, one tractor is the rule there is generally a higher standard of maintenance. It is interesting to observe that farmers and workers who are interested in livestock seldom have such a keen interest in machinery, and this is often reflected in the standard of maintenance achieved. Bearing this observation in mind, one realizes that the smaller mixed farms employ labour with a bias towards stock and often with a tendency to regard machinery merely as a necessary evil.

Dealer service arrangements

On this type of farm with, say, two tractors, one finds that tractors rarely record more than 600 to 800 hours per year. It is sometimes overlooked, however, that for every engine hour recorded which is based on an operating speed equivalent to about 1,500 r.p.m., the tractor will, in fact, be in operation a considerably longer time, possibly on light duties, transport and so on. This presents a real problem to the dealer who has organized a routine

system of service visits to farms, since farmers are reluctant to make their tractors available in spite of receiving advance notice of a call. Obviously, to make the service pay and yet keep charges to a minimum, the dealer has to ensure that there are enough machines to service in the day to cover the mileage and time involved in travelling. It is common knowledge that many of the guarantee period service vouchers are not used because farmers will not make the tractor available to the dealer as long as there is nothing apparently wrong with it! The manufacturers, realizing this, have done a good job in protecting tractors by generously-sized oil filters and adequate oil capacity so that a fair amount of abuse can be tolerated. Perhaps the reason why the diesel has become so popular on the small farm, in spite of the pronouncements of economists and others that the number of hours do not justify the extra cost, is mainly due to the fact that maintenance needs to be carried out at far less frequent intervals.

Now that the economic climate is changing it seems likely that tractors will be changed less often than in the past. This implies that a higher standard of care will have to be given to ensure reliability. I should like to see the farmer who does not employ anyone with an aptitude for machinery get his local agent to undertake servicing, preferably under a service agreement at a low, fixed charge plus materials. The greater the number co-operating in these schemes the cheaper it can become, but a typical present-day cost would be around £8 to £10 per year covering 4 to 5 visits. Few people realize that a recording of 800 hours per year on a tractor must at least be equal in wear and tear to 16,000 miles in a car. I wonder how many car owners carry out their own servicing on cars doing that mileage.

On-the-farm servicing

It is difficult to get factual information on the frequency and amount of servicing being carried out on farms. However, the following table, taken from a report published several years ago by the N.I.A.E. on various makes of tractors covered during their Farm Trials series tests, where tractors were tested when new and at the end of twelve months on farms of different sizes and types, shows a summary of maintenance actually carried out by the operators who were asked to follow the instruction book and record any maintenance given.

Summary of Maintenance Operations carried out by the Farmer

	Farm A	Farm B	Farm C	Farm D	Farm E
Greasing (No. of times/week)	1½	1/5	2	1½	1/3
*Engine oil changes	4(8)	3(6)	7(7)	8(10)	7(6)
Engine oil additions (pt.)	13	6½	25	21	26
*Transmission oil changes	0(1)	0(1)	0(1)	0(1)	0(1)
Transmission oil additions (pt.)	0	0	4	0	1
*Air filter oil changes	54(97)	0(75)	0(84)	5(123)	3(76)
Air filter oil additions (pt.)	0	0	0	0	0
No. of times battery topped	1	2	0	0	0

*The figures given in brackets show the number of changes advised by the manufacturer for the particular periods covered.

The number of hours was recorded by a special recorder which registered the actual hours when the tractor engine was running. In practice the recorded hours varied from 750 to 1,230 during the year. Incidentally the general condition of the engines at the end of the year was in all cases satisfactory, although cleaning of the injectors, changing the oil and attending to the filter in the air cleaner invariably resulted in a 2½ horse-power increase in power available.

Although the table may not be typical of actual practice, since the operators knew that records were, in fact, being kept, it is possible to see that certain items which have a direct effect on performance were being neglected, air cleaners, injectors and batteries in particular.

Some major items which would rate as equally important were not mentioned on the first test, but were included in a later test, a report of which was recently published. This test showed that excessive zeal was shown by five out of six operators in changing the oil much more frequently than recommended; in one instance twenty four times, instead of the seven recommended. Maybe this item has been given sufficient publicity. On the other hand brake adjustment was completely neglected by three out of six operators. During the examination of young farmers and students for proficiency tests one always gets the correct answer to questions on greasing and engine oil changes, but never the same readiness to mention other vital maintenance tasks such as adjusting the fan belt and cleaning off the radiator fins to prevent overheating.

In both the tests referred to, no one changed the oil in the transmission during the full period. Admittedly the change had only just become due. What is perhaps not generally known is that oil sent out in the transmissions of many tractors is inhibited to prevent corrosion of the transmission during storage, prior to delivery on the farm. This oil is perfectly suitable for normal operation, but it has the tendency to thicken more quickly than is the case with a normal oil. A number of cases have been brought to my notice where changing the oil in the transmission, which also serves the hydraulics, has improved the speed of operation when lowering tipping trailers and front-end loaders. In this respect it is worth noting the result of another N.I.A.E. test on one of the recently-developed multi-use type oils now available. This oil has been developed so that a single grade of oil can be used in the engine, gear box, transmission and hydraulic system, and many of the tractor manufacturers now approve its use on the newer types of tractor. In the test under cold conditions and using a front-end loader for loading trailers, a comparison was made between the rate of work achieved using the thin oil and the thicker normal transmission oil. The time required for the trailer body to return to normal during the first run was 7 minutes 10 seconds, using tractor gear oil. This compared with 2 minutes 8 seconds for the first trip with the multi-use oil. After several further tests, although the time taken on both oils was reduced, the ratio remained fairly constant at 3 to 1 in favour of the thin oil.

Workshop and equipment requirements

Every means possible must be found to make the servicing of tractors and other machines as simple and straightforward as possible and to concentrate

especially on the vulnerable and more costly parts. In particular I would emphasize attention to the air cleaner, and filling it with thin oil only to the correct level. This is especially necessary where the tractor is fitted with a pneumatic governor, otherwise full power will not be developed. On new tractors in particular, tyre pressures need adjusting to suit conditions. Tyre replacement is so expensive that raising the pressure is especially worth while when a lot of transporting has to be done during silage-making, harvesting and so on. The purchase of a small compressor or even a good garage-type hand pump can make the task more attractive and therefore more likely to be done. The size of the problem becomes more apparent if you start counting up the number of tyres in use on the farm. Any farm connected to the mains should now consider purchasing a battery trickle charger and not forget a carboy of distilled water. Batteries costing £20 each have often had their lives halved because six pennyworth of distilled water was not available at the right time.

For the numerous tasks where spanners have to be used, such as tightening wheel nuts, bleeding the fuel system and cleaning injectors, it is essential that they fit correctly. The old type Whitworth and B.S.F. sizes are no longer suitable for modern tractors and A/F sizes are required if nuts are not to lose their corners.

When equipping your workshop one of the first priorities is a good hydraulic jack for the wheel-changing ceremonies which take place from time to time. The workshop and/or tractor shed needs a good level concrete floor, plenty of light and a strong bench with a vice. Tractor lubrication charts make useful wall decorations and are available from your oil suppliers. A wall rack into which all the instruction books can be slipped is not difficult to make, and will enable quick reference to be made. Remember, the value of the instruction book is not only in telling you how to carry out the task, but how *not* to carry it out! This applies particularly to clutch and brake adjustments which should only be attempted after reference to the book.

When winter is not so far away I always remember the horror of seeing 14 tractors in one workshop with cracked cylinder blocks after the first cold snap of the year. Anti-freeze is not expensive, but do ensure that you use a type suitable for diesel engines.

The basis of good servicing is cleanliness; not only of the workshop and the tractors, which will instil pride in the user, but also of the fuel and oils. Oil-filling measures should always be stored upside down. It is surprising how seldom farmers realize that the ideal place to store oil is in a cupboard immediately under the fuel tank. Plans for a proper fuel-storage layout are obtained free on application to your oil supplier, and guidance on the minimum number of different oils that it is necessary to keep will gladly be given. With the new oils now available, one or at the most two types may be all that is necessary. Do ensure that your oil barrels are carefully labelled. The molasses barrel is exactly the same shape as the oil barrel, and I know of at least one tractor transmission that came, quite literally, to a sticky end.

Agricultural Chemicals Approval Scheme

Additions to the 1961 List of Approved Products

THE following additional products have been approved under the Agricultural Chemicals Approval Scheme. The First List of Approved Products was published on 1st February, 1961.

INSECTICIDES

GAMMA-BHC (LINDANE)—*Emulsions and Miscible Liquids*

P.B.I. Lindane 20—Pan Britannica Industries Ltd.

DDT—*Wettable Powders*

Bugge's DDT 50% Wettable Powder—Bugge's Insecticides Ltd.

MALATHION—*Sprays*

Malathexo 60—Pan Britannica Industries Ltd.

PARATHION—*Sprays*

Fosfex—Pan Britannica Industries Ltd.

FUNGICIDES

ORGANO-MERCURY FOLIAGE SPRAYS

Baywood Liquid Mercury—Baywood Chemicals Ltd.

ZINEB—*Dusts*

'Zibenide' Dust—Plant Protection Ltd.

ZINEB—*Wettable Powders*

Dithane Wettable—Pan Britannica Industries Ltd.

'P.P.' Zineb Fungicide
'Zebenide' (available in Channel Islands only) } Plant Protection Ltd.

Zelmone—Baywood Chemicals Ltd.

HERBICIDES

2,4,5-T-ESTER SPRAYS

Marks Brushwood Killer—A. H. Marks & Co. Ltd.

SEED DRESSINGS

ALDRIN LIQUID SEED DRESSINGS

For reducing attacks of wheat bulb fly on winter wheat, by over-treating seed already dressed with certain liquid organo-mercury dressings. Because of the risks to wild life, users are reminded that these dressings must only be used on autumn and winter wheat where there is a real danger of attack from wheat-bulb fly; they must not be used at all for spring-grown grain.

Astex—Shell Chemical Co. Ltd.

SEED DRESSINGS *continued*

GAMMA-BHC DRY SEED DRESSINGS

For over-treating seed already dressed with an organo-mercury compound, to check attacks of certain soil pests e.g., wireworms. When used at higher rates than those for wireworm control, these dressings are suitable for reducing attacks of wheat bulb fly on winter wheat.

'Abol' Gamma Seed Dressing—Plant Protection Ltd.

MISCELLANEOUS

METHAN-SODIUM—*Liquid Formulations*

Vitafume—Vitax Ltd.

WOUND SEALING MATERIALS

For application to cut surfaces of trees and shrubs, after pruning or wounding, to form a protective seal.

Arbrex 805—Pan Britannica Industries Ltd.

Reminder: Seed Dressings and Risk to Wild Life

Dressings containing dieldrin, aldrin and heptachlor can kill birds that eat treated seed. Great care should be taken not to leave any treated seed lying about when it is being stored or sown. Higher strength dressings for wheat bulb fly should be used only on winter wheat and then only in areas where there is a real danger of attack.

Dressings containing dieldrin, aldrin and heptachlor are not to be used at all for spring sown grain.

Plant Growth Substances

R. L. Wain, D.Sc., F.R.S.

Wye College, University of London

Fundamental research into the natural growth hormones of plants has given us a wide and increasing range of synthetic compounds whose uses are varied and sometimes unexpected.

The discovery that the growth of plants can be modified by the application of extremely small quantities of certain chemicals has given rise to developments of great agricultural importance. The chain of events which led to this discovery began with the observations of Charles Darwin in 1880, whose experiments led him to conclude that some "influence" was transmitted from the tips of roots and shoots which controlled their direction of growth. Since then many research workers have added to our knowledge, and it is now known that plant growth is under the control of highly active chemicals known as growth hormones which occur within the plant itself.

The most important plant hormone is 3-indolylacetic acid (IAA). This substance is produced in actively growing regions such as the stem and root tips, young leaves and developing seeds of many plants and it is also found

in other parts, as well as in pollen. It is of interest to note that IAA was known as a chemical for fifty years before Kôgl found it to be a plant growth hormone in 1934. This discovery led to big developments, for here was a substance that could be made in the laboratory and when applied to plants could exert profound effects on growth not only at the site of application but also in other regions of the plant to which it became transported. Since IAA is a fairly simple substance, it was logical for chemists to synthesise other compounds of a similar nature and test them for their capacity to produce growth responses in plants.

These researches paid a rich dividend, for many new active compounds have been discovered. These synthetic materials, it must be noted, do not occur naturally in plants and are therefore not hormones; they are better described as plant growth substances. Amongst them may be mentioned the well-known compounds 2,4-D (2-4-dichlorophenoxyacetic acid) and MCPA (2-methyl-4-chlorophenoxy acetic acid). The striking feature of such materials is their potency; some of them will produce an effect on plant growth at a concentration as low as one part per million of water. They are able to pass rapidly into roots, leaves or stems and are then translocated within the plant. At low concentrations they may affect growth beneficially, but when applied at higher strengths some of them may produce disastrous effects which kill certain species completely. Yet with the dosage rates used in practice, these materials are not poisonous to man or animals, nor do toxic residues from them persist in the soil.

So far the greatest use of growth substances has been in protecting crop plants from weed infestation. For example, 2,4-D and MCPA are typical "selective" weed-killers which, applied at 4–32 oz per acre can destroy many species of broad-leaved weeds while leaving grasses and cereals unharmed. They are therefore valuable in clearing weeds from cereals, pastures and lawns.

Research work on plant growth substances is proceeding on many fronts. Fundamental investigations on the relationships between chemical structure and growth-regulating activity help us to understand their mode of action, and often lead to the discovery of new active chemicals. Studies are also being made on the physiological changes brought about by growth substances acting within the plant; the effect on respiration of tissues, on water uptake and on membrane permeability are all important in this connection. In all such work it is necessary to have team work, with close collaboration between chemists and biologists.

More closely selective weed control

In spite of all the research which has been done, no growth substances have yet been found which deal preferentially with grass weeds, though there are other types of chemicals available for this purpose. There have been some interesting developments with growth substances, however, towards achieving further specificity in selective weed control. One of these developments arose from biochemical investigations at Wye College in which a number of chemicals were discovered which are themselves inactive in regulating plant growth but may be converted to active growth substances within the tissues of certain plants. The new weed-killer MCPB (γ-(2-methyl-4-chlorophenoxy) butyric acid) is a chemical of this type; it is relatively harmless, for example,

to clover plants and certain varieties of peas, yet is converted to the active growth substance MCPA by many weed species. Another such compound is 2,4-DB (γ-(2,4-dichlorophenoxy)butyric acid), used for selective weed control in clover and lucerne. Both MCPB and 2,4-DB at 24–48 oz per acre are used for controlling weeds in undersown cereals. Another advantage of these materials is that they can be safely used on cereals at an early stage, when 2,4-D and MCPA would prove injurious. From the general viewpoint, it is of interest that the discovery of the "butyric" herbicides has provided a new approach to selective toxicity in that the organism which succumbs is responsible for bringing about its own destruction. Studies along these lines and related biochemical investigations are continuing, and may lead to further agricultural developments.

In another aspect of the work at Wye, chemical modifications are made in active molecules such as that of 2,4-D. These investigations give rise to new chemicals whose plant growth-regulating activity is then carefully assessed. It is known that this property may give a good indication of the herbicidal activity of the compound; this was indeed the case with the compound CMPP (α-(2-methyl-4-chlorophenoxy)propionic acid), a chemical which was first prepared at Wye in 1953 and which proved to be as active a growth substance as MCPA. It was later found by other workers not only to be a highly specific selective weed-killer, but also to have a wide weed-killing spectrum. Thus not only does CMPP, used at 24–40 oz per acre, destroy most of the weeds which are controlled by MCPA but it also provides an effective control of cleavers and chickweed—weeds which are somewhat resistant to MCPA. A further interesting property of CMPP is its toxicity to clovers, and it is now being used for treating lawns to remove these species.

Another hormone-type weed-killer is 2,4,5-T (2,4,5-trichlorophenoxyacetic acid), a compound similar to 2,4-D and MCPA which, however, is more active in destroying woody plants and is used as its ester for this purpose, usually together with the ester of 2,4-D.

A somewhat different compound, 2,3,6-TBA (2,3,6-trichlorobenzoic acid), is also a selective weed-killer which is highly active as a plant growth regulator. It is used at 8–16 oz per acre; mixtures with MCPA are also employed as selective weed-killers in cereal crops and give a better and wider degree of control than MCPA alone.

Never let spray drift

Hormone-type herbicides are usually applied in solution in the form of their sodium, potassium or amine salts; and esters, formulated in miscible oil emulsions, are also available. Because of the low concentrations which are able to affect plant growth, the drift hazard with all these materials can be appreciable, and great care must therefore be taken in spray application. It is also important to ensure that spray machinery and equipment which is to be used for any other purpose is properly cleansed. For further information on all these points and on the herbicidal performance of the chemicals discussed above, the Weed Control Handbook issued by the British Weed Control Council* should be consulted.

In all chemical weed control operations, success may be influenced by climatic factors as well as by soil type and situation. In many cases it is not

*Weed Control Handbook (2nd Edition) Blackwell Scientific Publications Ltd. 17*s.* 6*d.*

necessary for the applied chemical to kill a weed outright, for as the crop develops, its smothering action will either destroy the weeds or keep them so small that their competition with the crop will be negligible. A thin, poorly growing crop, however, will not provide the competition necessary to prevent the recovery of weeds which have been checked and not killed by spraying. It follows, therefore, that good farm management in conjunction with chemical weed control is the best means of keeping land clean with the most economical use of labour.

Rooting cuttings

Another important use of plant growth substances is for the rooting of cuttings. This represents an important method of plant propagation, because a rooted cutting develops into a plant which, unlike those raised from seed, is always "true to type" and shows all the characteristics of the plant from which the cutting was taken. Root production is normally promoted by the action of a natural growth hormone which moves down to the base of the cutting from the leaves and buds, so that when this natural hormone supply is supplemented by treating the base of the cutting with a suitable growth substance, the rooting response is often greatly accelerated.

The literature on the use of growth substances for the rooting of cuttings is extensive. Two of the most important chemicals for this purpose are IBA (γ-(3-indolyl)butyric acid) and NAA (α-naphthylacetic acid) both of which have the advantage of not moving readily from the base of the cutting following application. The concentration which is most active for rooting, however, is often close to the toxic concentration, and it is therefore most important to follow the makers' instructions closely in regard to treatment. The safety margin is greater with IBA than NAA; furthermore, IBA usually produces a small number of roots which grow rapidly to form a strong fibrous system. There are various methods of treatment, the simplest being the application to the base of the cutting of an inert dust containing an appropriate quantity of the growth substance (0·02–0·1 per cent for herbaceous cuttings and 0·1–0·5 per cent for hard wood cuttings).

Growth substances are also used commercially for preventing the "pre-harvest drop" of apples, pears and certain other fruits. This premature falling of fruit is due to the cessation of hormone production by the developing seeds; this leads to the formation of a layer of specialized cells—an "abscission layer"—at the base of the fruit stalk which is not strong enough to bear the weight of the fruit. Spraying the tree at the right time with a very dilute solution of a growth substance often prevents the formation of the abscission layer, and so ensures that the fruit will remain on the tree until picked. In this way, losses as "windfalls" may be greatly reduced, though under certain conditions a hastening of maturity of fruit may result from this treatment.

Of the many growth substances tested for capacity to prevent pre-harvest drop, NAA is probably the most versatile. It is used as its sodium salt in solution at about 10 parts per million of water. Some varieties of apple and pear, however, do not respond satisfactorily to this treatment, and it is probable that in these cases the appropriate compound remains to be found.

Setting seedless fruit

Another important application of growth substances is their capacity to cause unfertilized flowers of certain species to "set". The result is a seedless or parthenocarpic fruit, quite different from the seeded fruit which develops as a result of pollination and fertilization. These natural processes themselves, however, do not influence the growth of the fruit tissues directly for in most cases the growth of the fruit is controlled by hormones produced by the developing seeds.

Fruit setting sprays contain a growth substance such as NOA (2-naphthoxy-acetic acid) at very low concentration, together with a wetting agent to ensure good coverage of the flower parts. Although such sprays are effective with a number of species, they have so far only been used commercially in this country on tomatoes. When such a spray is applied to an open tomato flower truss, the unfertilized ovaries develop rapidly and a good set of seedless fruits, all of which grow to uniform size, is obtained. With outdoor tomatoes, when climatic conditions are such that natural setting is poor, spectacular increases in yield may be obtained by growth substance treatment. In a field trial carried out at Wye, for example, spraying the bottom trusses led to an increased yield of some 300 per cent. It is very important when using fruit setting sprays to use the exact strength given by the manufacturer. Many a grower has obtained a poor yield of malformed fruits by exceeding the recommended concentration.

Other uses of plant growth regulators in agriculture could have been discussed in this account. A wide range of active substances is now available, and as research proceeds there is no doubt that more uses will be found for these versatile compounds. Again it must be stressed that the agricultural developments have all arisen from fundamental investigations on natural growth hormones. As the chemist and biologist pursue their joint researches within this field, the problems of plant growth and development are becoming better understood. Thus, the use of modern analytical techniques and sensitive methods of bioassay have made it possible to determine the hormone content of various parts of a plant at different stages of its growth. From this work it has been established that the normal growth of plants depends not solely on hormones, as was at first thought, but also upon the presence of hormone inhibitors, which, it is believed, may be of particular importance in relation to dormancy.

Other physiologically active compounds such as gibberellins also occur in plants, and all have their part to play in Nature's well-planned chemical control of growth. As these natural processes become better understood, new and important agricultural developments may be expected.

Correction

Britain's Broiler Industry (B. J. F. James, August issue, p.272, line 4): For "1s. 5d." read "⅛d."

Care of a Working Collie

W. Fife

Blinkbonny, Alnwick, Northumberland

Mr. Fife, who has had a life-time interest in sheep dogs and sheep dog trials, including judging this year at Blackpool and Kilmarnock, describes briefly what to look for in a working collie and the care and training which it needs.

The selection of a Border Collie pup is very largely a matter of personal preference. Aims may be different to begin with. One will have in mind a strong working dog for the hills; another one a dog which will perform with style, power and skill on the trial field; while for many a faithful companion is all that is desired.

If trial work is the aim it is perhaps better to go for the offspring of registered parents. Such a dog can be worth a lot more in later life for breeding or stud purposes. For a working or show dog, it doesn't much matter. For the rest, everyone has his own ideas for picking out the best in the litter. Half a dozen can go and each come away convinced that he has the right pup.

My personal preference is for a nice black and white. Although there is nothing in colour so far as performance is concerned, black and white is much more attractive than, for example, all black. The head should be characteristic of the sex, broad and strong in a dog, narrower and distinctly feminine in the bitch. The legs should be straight and the tail carried straight down behind, with an upward curve at the end. Temperament is all-important. Some go for the quiet and others for the active pup. But there is a lot to be said for the one which is neither too shy nor too boisterous—which sits up and takes notice, looks alert, and has dark rather than light eyes.

Feeding

Selection is only the beginning. A lot of care and good feeding are required if the dog is to become healthy and strong.

The pup you take home will probably be about eight weeks old. If he is in good condition it is best to worm him right away. If he is rather weak it is better to wait until he improves and treat him at say ten weeks of age. People have their own ideas about worm medicines but my advice is to go to your local veterinary surgeon for tablets and instructions on how to use them. He is also the man to inoculate the puppy against distemper at three months old.

To begin with, food should be given in small quantities four times daily. One feed should be meat. Liver is particularly good, and there are several brands of tinned meat available quite suitable for growing puppies. The other feeds can be puppy meal, of which again there are several suitable brands. Milk is an addition which puppies like and, for weaklings especially, a raw egg broken into the food once a day will work wonders. Cod liver oil, mixed in with the feed say once or twice each week, is another good thing.

Meals can be reduced to three per day at four to five months, to two at six to seven months, and to one at nine to ten months. The single meal is best given at night. Like ourselves, a dog doesn't work well on a full stomach.

So far as quantities are concerned, the best guide is the condition of the dog. Puppies should be well fed in the early stages, but over-feeding is bad at any time. Mistaken ideas about kindness have shortened many a good dog's life, especially those kept as pets. Food not cleaned up is a sure sign that too much is being given, always provided of course that the dog is healthy.

Training

Ideally, growing puppies should be out every day and all day and not exposed to the hazards of traffic. Even where the aim is purely a good working dog for the farm, it is advisable to train the dog to the lead. Some owners don't bother, but dogs that won't lead can be an awful nuisance later on and in my opinion it is the right way to start them off in their working life. Start early. Introduce him gradually to the collar and the lead, encourage him to answer to his name, and it won't be long before he begins to get confidence and to follow you about. Dogs should be handled firmly but gently and quietly. Exceptionally a dog may require really strict treatment, but in general they respond best to kindness. To be of any use, a dog must have confidence in his master, and he won't get it if he is shouted at or bullied.

At about eight or nine months your puppy will probably begin to take a real interest in sheep and to "show eye". Some puppies take longer to come forward than others, and it is rather a question of studying the requirements of your own dog than of following a rule. He may want to run at six months but unless he is fairly strong he should not be encouraged; at this age he will not have the speed to work the sheep properly, and may consequently develop habits which can lead to complications later on. Very often the dog which starts to work at twelve months is the best in the end.

Whatever the age at which he starts, this is the time when he begins to learn working commands. Great care and plenty of patience are needed when beginning this part of his training, especially during the first six months. As I have mentioned already, puppies vary tremendously. Some are natural runners, others need to be directed all the time. Study your dog and treat him accordingly. Aim to keep him as "mild" as possible. Realize that it's a long job and that you won't train him in six months. Make it clear what you want him to do; at this stage one bad mistake on your part can ruin a potentially good dog.

It is at lambing time that he really learns how to control sheep and it is then, when it is often necessary to drive a single ewe, that you begin to know whether you have a good dog. He will be working hard now, and probably the best feed for hard work is biscuits and milk, with a few tasty tit-bits now and again.

Worming is advisable when lambing is over, to make sure that he is fit for the summer months. After clipping there is usually plenty of varied work for training. Now he should be taught to cast well out for his sheep and to bring them steadily on without too much fuss.

Training is largely a question of establishing confidence and understanding between man and dog, and not something easily learnt from a book. But given kindness and patience in the man, the brains and the right temperament in the dog, what a wonderful partnership it can be.

Practical Points in Shelter-Belt Planting

H. L. Edlin

Forestry Commission

From October to April is the time for planting trees. A well-sited shelter-belt may be of value to you, and you could have no better guide than Mr. Edlin.

As one goes about the country today, it is surprising how many young and newly-planted shelter-belts catch the eye. To a forester, it is very gratifying to see that a material benefit from raising trees—the provision of protection against the elements—is appreciated so widely by the farming community. This is true not only of the uplands—where belts often make possible the proper farming of exposed slopes that would otherwise only provide rough grazing (see p. ii of the art inset), but also of fertile plains. Often the belts have been sited on small strips of ground, such as gullies along streams, which are not ploughable, but here and there really good ground is being used for shelter rather than for direct production.

Obviously there must be, on balance, some compensating increase in output to justify the cost of these belts. No comprehensive figures are available for Britain, but in America and Russia it is estimated that appreciable shelter can eventually be given to all the ground by withdrawing only 5 per cent of it from direct production to grow shelter trees; the resulting increase in output, under their conditions, is about 20 per cent.

The Ministry's Fixed Equipment of the Farm Leaflet No. 15, *Shelter Belts for Farmland**, gives a full account of methods for establishing belts under most conditions. For the dweller in the severe surroundings of the western hills, there is Forest Record No. 22, *Shelter Belts for Welsh Hill Farms*, by W. A. Cadman of the Forestry Commission.† This present article deals with some practical points arising in the execution of planting schemes.

Planning ahead

The actual planting of the trees can only be done during their resting season —from October to April, and then only in periods when the ground is free from frost. Nurserymen who raise planting stocks, and contractors who will do the whole job, are already busy filling their order books. Time must be allowed for fencing, draining and ploughing, and approval of the schemes for grants; much of this may have to be fitted into slack periods on the farm.

Decide first whether you will tackle the work yourself or call in a contractor. In most districts there are now reputable forestry contractors with considerable experience who will do the whole job—preparation of ground, planting, and after care; they are knowledgeable men whose ideas on choice of species and similar points merit respect. Naturally, though, they make a

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*H.M.S.O. Price 1*s.* 6*d.* (by post 1*s.* 8*d.*)

†H.M.S.O. Price 2*s.* 0*d.* (by post 2*s.* 1½*d.*)

reasonable charge for their services, and there are substantial economies in doing the work oneself with farm staff at times when the men are not fully employed, but it is most important to secure sound advice.

Such advice—and in appropriate instances financial aid also—is available from either of two sources; not, of course, from both for the same belt! The Ministry's Agricultural Land Service is concerned with the payment of grants under Farm Improvement Schemes (one-third cost), or belts on livestock-rearing land (one-half cost). Or the Forestry Commission will pay a fixed sum of £21 per acre, provided timber production is a main object of the plantation. Remember that both these agencies will gladly give advice even if you do not intend to apply for any sort of grant; the people who come to see you will be familiar with your local conditions of soil, climate, and farming practice.

Siting and fencing

There is an obvious economy in siting a belt alongside an existing fence, but few people realize how great this saving is. Taking a belt of average width—one chain or twenty-two yards—there will be a length of ten chains for every acre occupied by trees. Simplifying things a little, it will cost £50 to plant that acre (including plants, preparation of ground, and after-care), and £50 for the fencing on either side of it, making £150 an acre in all. But since one fence is required in any case, the net cost of the belt—if sited along a desirable fence line—is only £100 per acre, or £10 for each one-chain run.

If, however, existing fences are in a poor condition and need renewal anyway, it is worth while to consider whether they run along the best lines from the shelter angle. The field layout may perhaps be improved by replanning, at no extra cost.

The fences on both sides of a belt should be stock-proof, for even if there are no stock grazing on one side when the belt is established, it is likely that they will be there at some later stage. As a general rule, trees thrive best when livestock are permanently excluded, but an established crop in the pole state suffers little if beasts are let in for a few days to shelter during an exceptional winter storm.

Whether rabbit netting need be added to the stock fence depends very much on the district, and the degree of control that the farmer has the time and the means to exert. But if there is any real risk of rabbit attack, netting must be used.

Ideally, fields should be sheltered on all four sides, and examples of such fields, usually highly-productive, can occasionally be found. As a rule, however, all that can be done on an economical scale is to provide shelter, by a series of parallel belts, against the most damaging wind direction. The man on the spot will usually know this already.

In the south and west, it is commonly the south-west wind that causes most concern, but along the east coast the north-easters do more damage. In the uplands the canalized winds that blow with surprising force along the valleys can prove serious, and there the best lines are those at right angles to the valley's course, regardless of compass direction (see p. ii of the art inset).

There is a considerable advantage in siting a belt along a hedge, or even a dry-stone dyke. As the trees get older, they tend to open out at the bottom

leaving a gap through which the wind can whistle. The Scots pine belt on the light easily-blown sands of East Anglia, which is pictured on p. ii of the art inset, shows such a gap. On page iii of the art inset a mixed belt of Corsican pine and beech on the chalk downs is depicted, showing how a hawthorn hedge along one side will close the gap effectively.

Ploughing and draining

Either of these operations, and sometimes both, may be advisable. It is simplest to carry them out before fencing is completed, because then the work of the tractor is not obstructed. Some belts are planted along dingles where the ground slopes to a stream. Such land may be impossible to plough and may be naturally well-drained, and will give good growth because conditions favourable for trees are already present.

Ploughing is a useful aid elsewhere, and it costs little. Foresters have developed special ploughs for their difficult soil types, such as deep peat or hard heaths. But on the easier conditions of farm grazings an ordinary tractor-drawn plough, preferably single-furrow, will suffice. For tree planting the ground is only partially ploughed, at a convenient spacing for the lines of trees—usually five feet apart. Full ploughing shows little or no advantage, possibly because the open furrows left by partial ploughing provide better drainage channels for the young trees. As a rule, the young trees are planted through the slice of earth and turf left by the plough; exceptionally, in dry eastern districts, they grow better if planted in the furrow bottom.

Though trees must have water, they cannot thrive where it lies stagnant in the soil. Damp places must therefore be drained, with open ditches because tree roots would soon clog tile or mole drains. If the ground has been ploughed, the drains should cross the furrows at suitable points, to collect the water that runs down the furrows.

Choice of species

Nearly every tree that grows to a reasonable size will provide shelter, so there is a strong temptation to think of unusual mixtures and kinds. In practice most new belts today are of one kind, selected from among only half a dozen common trees, each with its merits.

Japanese larch, *Larix leptolepis*, is undoubtedly our quickest-starting tree, and it tolerates a surprising range of soil and climatic conditions. When grown in exposure it is apt to be bent at the butt, and fast-grown leading shoots are often crooked; it is not evergreen, and its timber does not yet enjoy a high reputation, though the heartwood is durable. But these are minor drawbacks if you want shelter quickly, for this tree will often grow three feet taller each year. European larch, *Larix decidua*, will not stand such great exposure, and needs better soil, but it has a durable timber that is more highly esteemed.

Under the severe exposure of the western seaboard, the only tree worth considering is the Sitka spruce, *Picea sitchensis* (see p. iii of the art inset). It is rather slow to start, but soon begins to grow taller, by about two feet a year; its leading shoot always stands upright, despite buffetting by the gales. The Norway spruce *Picea abies*, will not stand seaside exposure; it is useful inland in moist hollows liable to frost.

Neither larches nor spruces thrive on dry, acid soils in eastern districts, and there the standby is the native Scots pine, ***Pinus sylvestris*** (photo. art inset). This is a relatively slow grower, seldom exceeding a foot a year, but is both hardy and reliable, though not at home on the coast.

Chalk and limestone soils call for other trees, since few conifers thrive on them after twenty years of growth. A common solution is to grow Scots pine and beech (*Fagus sylvatica*) in equal, intimate, mixture. After twenty years or so the Scots pine, which has served to nurse up the beech, is removed as small poles, and the beech continues growth, providing a lasting screen. An alternative pine for the mixture is the Corsican pine, ***Pinus nigra*** var. *calabrica* (see p. iii of the art inset) which does well where some mineral soil overlies the chalk; the allied Austrian pine, *P. nigra* var. *austriaca*, tolerates almost pure chalk, and also sea winds, but it grows slowly.

Planting

The commonest planting distance is five feet apart each way. This figure is a compromise based on experience. If an odd tree fails, the ten-foot gap that results is not serious, and the normal twenty-five square feet of space per tree allows most kinds to develop to the first thinning stage. In shelter-belts, the rows should be "staggered" so that the trees of each row stand opposite the gaps in adjacent rows.

A five-foot spacing needs, in theory, 1,750 trees per acre. Because the outer rows are set back from the fences, rather fewer are used in practice. The surplus trees should be grown-on in an odd corner of a garden for filling in any gaps later on.

Notch-planting is the rule for all trees except spruces. Spruces benefit by turf-planting—that is—having their roots spread out below an upturned turf or plough slice.

The commonest fault is planting which is too kind and gentle. Whatever the method of planting, it is important to firm up the ground with the heel of the boot.

After-care

Weeding will often—though not always—be needed for the first few summers after planting; once the young trees raise their shoots above the weed growth it may cease. Failures, if they are numerous, should be made good with fresh trees during the first winter after planting. Fences must of course be maintained, and a watch kept for wandering rabbits.

Yet all in all a shelter-belt needs surprisingly little after-care. Once established, it will look after itself with far less attention than any other farm crop. After twenty years—or perhaps only fifteen with Japanese larch—one can reckon to harvest the first returns in the form of small poles removed as thinnings. But meanwhile the other benefits will have begun to make themselves felt—shelter extending to a distance twenty times the height of the belt and increasing yearly, cover for game, and no doubt an enhancement of the landscape attractions of the farm.

Farming Cameo: Series 2

42. Radnorshire: The Northern District

R. S. HUNTER-SMITH, M.A., DIP. AGRIC. (CANTAB.)
District Advisory Officer

RADNORSHIRE is reputed to be the least known county in Wales, a reputation it hardly deserves; both the scenery and the farming ought to be more widely appreciated. It may be the most sparsely populated county in England and Wales, but it can also claim to be one of the most heavily stocked with sheep.

The Northern district comprises the north-eastern third of the county, bounded to the west by the River Ithon which flows south from the Montgomeryshire border to join the Wye and to the south by the A.44 road to Aberystwyth. It is a truly rural district and has so far avoided the scars of industrial development. Knighton and Presteigne are the only towns of any size; both are situated on the county boundary. Knighton, on the Shropshire border, is well known to those who attend the Sheep and Store Cattle Sales. Presteigne, on the Herefordshire border, is the county town and is proud of the fact that it is the smallest assize town in the country; it is, however, no longer the administrative centre of the county.

The Hill Farming Scheme has contributed greatly to the rehabilitation of the hill farms of the district. Farmhouses and farm buildings have been modernized, farm roads have been improved, and extensive reclamation work has been undertaken. Forestry, also, has a place in the rural scene. The Forestry Commission alone has over 5,000 acres under plantation, nearly half of it planted in the last ten years.

Livestock rearing is the traditional system of farming; physical factors militate against any other. Undulating hills and narrow valleys form the pattern of the district, much of it above the 1,000 ft contour. The most intensively farmed land falls away to 500 ft on the Herefordshire border, where the Radnor Valley forms a wide basin. To the west, the hills rise to 2,000 ft. The soil shows only slight variations, being derived almost entirely from grey Silurian shales. It varies in texture from free draining silty loams to silty clays which suffer from impeded drainage.

In addition to the 60,000 acres of crops and grass, there are some 20,000 acres of enclosed rough grazing. Much of this is bracken—covered hill ground blessed with a good depth of soil; 6,000 acres have been reclaimed during the last ten years. Many holdings also have grazing rights on the 6,000 acres of common land.

About a fifth of the total acreage of crops and grass is in tillage. Except for a small acreage of wheat and barley and an even smaller acreage of seed potatoes, none of the tillage is used to grow cash crops. Feed for the winter and early spring is all important in an area where the winters are long and the springs late. Oats, swedes and rape account for over 80 per cent of the acreage under the plough. There is a strong belief in the district that oats on the sheaf are a first-class feed for breeding cows and stores; most of the oat crop is therefore not threshed. Part of the swede crop is clamped for feeding

to cattle, the remainder is sheeped off during the late winter and early spring. Only a few years ago it was thought that the days of the root crop were numbered. The introduction of the precision drill has, however, given it a new lease of life. Wether lambs, once sold as stores, are now fattened on the rape which has proved a valuable pioneer crop in the reclamation of hill ground. It also has a place as a catch crop taken before reseeding fields which are unsuitable for rotational cropping.

The cattle enterprise is based entirely on the sale of stores. Single suckling is the traditional method of rearing. Most of the cows are Herefords and rearing takes place outdoors. In the past yearling and eighteen-month-old stores were sold; some still are, but the trend has been to market cattle at a much younger age and to keep more cows on the farms for breeding. The £12 Hill Cow Subsidy has done much to encourage this trend which has led to the introduction of Weaned Calf Sales. Over 2,000 weaned calves are sold each year at Knighton alone. It is accepted practice to dehorn the calves and also to creep feed them for 4-6 weeks before the sales in order to get them accustomed to dry feed. The sales have encouraged earlier calving; well-grown calves are in demand and command a higher price. There is also a growing interest in self-feed silage for wintering both cows and young stock.

Sheep are the backbone of farming in the district; they are, in fact, the main source of income. The ratio of sheep to cattle is high, 10 : 1, and has not changed in the last decade despite a 50 per cent increase in numbers. An interesting and in many ways unique system of stratification has developed within the county based on the progressive crossing of speckled Welsh ewes with Kerry or Clun rams. In the Northern district Kerry crosses predominate.

On the upland farms speckled Welsh ewes are crossed with the Kerry. The ewe lambs of the cross are put to the ram and wintered on swedes. They give a 50 per cent lamb crop and are then sold as yearlings at the autumn sales. The foundation flock has to be kept hardy in order to make full use of the hill rights which go with these farms. This is achieved by buying speckled Welsh ewe lambs at local markets. At lower altitudes the first cross yearling ewes from the upland farms are crossed with the Kerry again. The ewe lambs of the cross are tupped; half to threequarters of them produce a lamb. They are then sold as yearlings or retained for one more year and sold as two-year-old ewes. These ewes attract buyers from all over the country and are used for crossing with the Down breeds for fat lamb production. Hardiness is again borne in mind when buying replacement ewes; they invariably come from farms where the climate is more rigorous. On the English border pure-bred Kerry flocks are to be found. One or two farms have also broken with tradition and gone in for fat lamb production.

Your Fixed Equipment

Treated Timber in the Farm Improvement Scheme

G. B. YOUARD
Agricultural Land Service

TIMBER is one of the oldest materials in the service of man, and it has long played a part on the farm. Unfortunately, under farm conditions, we have to be specially on guard against decay; e.g., a fencing post is subject to fungal attacks below ground and to the destructive effect of manure above. In the past the farmer's choice of suitable wood was limited to a few durable species, but now, thanks to the advance in knowledge of preservation, other woods may be made to last many years. Indeed a well-treated post of a perishable species that is receptive to preservative will outlast an untreated post of durable species. This is important to a farmer who has his own woodland, for now wood, hitherto useless except for firewood, will make useful fencing.

Since the Farm Improvement Scheme was introduced many hundreds of cubic feet of wood must have been used, and it is satisfying to feel that they will—or anyhow they should—last many years. For at the outset of the Scheme the Ministry of Agriculture decided that, as the improvements were to be permanent, only the best would do as far as preservation was concerned. There have, of course, been misunderstandings of the rules. That is only natural, because the benefits and techniques of wood preservation are still not widely understood. The Regulations provide that all: (*a*) round or half-round wood; (*b*) cleft or sawn wood, except that from the heartwood of oak, larch, sweet chestnut, yew or Western Red cedar; (*c*) plywood, except that consisting wholly of one or more approved durable species of wood, shall be preserved with creosote or other approved preservative if it is either:

> (i) in contact with the ground or manure; (ii) exposed to the weather and unpainted; (iii) enclosed in brickwork, masonry or concrete; (iv) liable to remain damp for long periods; or (v) inadequately ventilated.

The method of preservation, unless otherwise approved, is required to be impregnation under pressure or by hot and cold treatment in an open tank.

First let us consider the classes of wood that have to be preserved if they are to be used in vulnerable positions.

Of our home-grown woods, there are only four which in their heartwood are classed as durable—oak, larch, sweet chestnut and yew. Western Red cedar has been added to the list of exempted woods because it is being used in prefabricated buildings. The first three have traditionally been the species used for fencing and gates. A lot of people believe that if their fencing is made of one of these woods, be it round, half-round, cleft or sawn, it is safe from decay for a long time. But this is not true for round and half-round wood, and it may be wrong for cleft and sawn wood. When we speak of a

durable wood we refer to its heartwood and not to its sapwood. Round wood must necessarily contain an outer band of sapwood, cleft wood in the sizes used for fencing is rarely free of it, and sawn wood of the class mainly used for fencing may contain a substantial amount.

Of course size comes into it. In the larger sizes round wood of a durable species will naturally last a long time without treatment, because there is a larger proportion of heartwood which will be durable when the sapwood has perished. But fencing wood is mostly of small diameter, and when the sapwood has gone there is not enough substance left in a post for it to do its job. For example, take a round intermediate post of oak with a top diameter of 3 inches, the size required by the Farm Improvement Scheme. This may well have a sapwood band ½ inch wide, which means that only about four-fifths of its substance is heartwood. Now the sapwood of oak is particularly perishable and we may expect that before very long that post will be reduced below ground to 2 inches diameter. This just would not be good enough for a permanent improvement. The sizes of posts required under the Farm Improvement Scheme are right for the job they have to do; it would be extravagant to call for unnecessarily stout posts to allow for decay. So treatment is the only answer.

Plywood is in a class by itself. There are so many species which may appear in plywood that a list of those that may claim dispensation is impracticable in rules of this sort. Plywood is used mainly for cladding, and so an applicant who wishes to avoid preserving or painting must seek Ministry approval.

The next part of the rules deals with the five conditions in which wood must be treated. They are self-explanatory. There is no room for argument on the first three; the last two have to be decided by the inspecting officer but with these, too, there should be no difficulty.

Finally, the methods of preservation. It does not seem to be generally understood that the degree of protection obtained depends, on the whole, more on the *depth* to which a preservative is forced into the wood than on the type of preservative used. There are five ways of applying preservative. In order of efficacy they are: pressure treatment, "hot and cold" treatment in an open tank, steeping, dipping and brushing (or spraying). There are many excellent preservatives on the market but some of them for various reasons are not applied in this country by pressure or by the "hot and cold" method. Because the Ministry looks for permanent improvements, it has to insist on lasting protection; so only the more efficacious methods are allowed, namely, treatment by pressure or by the "hot and cold" method. Applicants' proposals are not infrequently turned down because the *method of application* is unacceptable, not the preservative. It is true that the Ministry *can* allow other methods (that is what the words "unless otherwise approved" mean) but it does so only in exceptional circumstances.

The country is adequately covered for the supply of pressure-treated timber. It may cost farmers a little more than untreated wood but it is insignificant compared with having a wood that will last. The "hot and cold" method, properly done, is most satisfactory and is particularly useful for the "do-it-yourself" man.

If you want to know more about the Farm Improvement Scheme and conditions of grant, ask the Divisional Office of the Ministry for a copy of the explanatory leaflet.

In Brief

THE TRAFALGAR TREES OF AMESBURY

The higher slopes of many downlands of the chalk country of south and west England are crowned with clumps of beech trees. Some of these were planted by eighteenth century landowners to improve the scenery, while others were created as deliberate landmarks to identify particular localities and routes across the open chalk uplands. But those seemingly casually-scattered beech clumps seen near the main road (A.303) between Amesbury and Stonehenge, in Wiltshire, have a more unusual story. They are the subject of our cover picture this month.

These trees were planted by the Antrobus family, then owners of nearby Amesbury Abbey, shortly after the Battle of Trafalgar, in 1805. Each separate beech clump represents a ship, and the whole set of clumps, dispersed over many acres of park-like countryside, represents the actual dispositions of the English and French fleets as they were at the commencement of the battle. From ground level this may not be very apparent, but from the air the setting for the engagement is clearly seen.

One wonders whether there may not be other similarly unusual landscape features commemorating incidents in our history.

COCCIDIOSIS

Coccidiosis is a major disease of poultry. It also causes losses in cattle and sheep, particularly among young stock maintained under intensive conditions, and is of importance in rabbits and game birds. Detailed assessments of the numbers of livestock lost and annual financial losses from the disease are difficult to obtain and, furthermore, such estimates usually do not take into account the cost of premedicating poultry foods with coccidiostatic drugs.

The disease is caused by various species of minute organisms called coccidia, which contaminate food and water. When they are swallowed by a susceptible animal the coccidia multiply within the body, usually in the intestine, and if present in sufficient numbers may cause severe damage. If the animal survives the infection, large numbers of coccidia, now called cocysts, are produced and passed out in the droppings to contaminate the animal's surroundings, food and water. In dry bedding, dry litter or on dry soil the cocysts are quickly destroyed, but in suitable conditions of moisture and temperature they become infective after approximately 2 days. Once infective they can survive in moist conditions for long periods, particularly where they are protected from direct sunlight.

Animals infected with coccidia simultaneously develop a resistance to subsequent re-infection; this helps to protect them from future exposure to concentrations of cocysts which would otherwise prove fatal. The aim of successful husbandry, therefore, is to expose animals to sufficient coccidia to induce an adequate resistance without, at the same time, subjecting them to the risk of severe disease. Intensive methods of husbandry tend to upset this balance in favour of the coccidia rather than the host animal, particularly in the present-day poultry industry.

Both in the production of table poultry, and more recently in the raising of replacement birds, very intensive methods of poultry keeping have become an economic necessity. It is evident that under such intensive conditions birds may be exposed to more coccidia than they can resist unaided, and that some form of continuous preventive treatment may be necessary to keep the rate of mortality down to a minimum and to maintain steady growth rates.

Initially, the greater exposure to infection in such flocks was indicated by an increased incidence of caecal coccidiosis among birds up to six weeks old. However,

as new systems of husbandry lead to birds becoming more and more crowded together, cocysts of other species of coccidia, notably those which are responsible for intestinal coccidiosis, were able to accumulate in numbers sufficient to cause disease. Also it became evident that some of the various preventive treatments employed originally to control caecal coccidiosis were having little effect on the intestinal species. Recently, therefore, it has been customary to test new compounds against a number of different species.

It must be emphasized, however, that in the absence of other control measures continuous medication alone will not prevent coccidiosis. If sufficient infection is present, losses will occur even in birds which are receiving coccidiostats at the recommended concentrations.

Preventive medication should be regarded as an adjunct to good husbandry and not as an alternative.

S. F. M. Davies

SURVIVAL OF WILD OAT SEEDS

The Ministry's Experimental Husbandry Farm at Boxworth, Cambridge, has been investigating the survival rate of wild oat seeds under long leys. By regular autumn ploughing of portions of a three-year ley put down in 1953, the following figures have been obtained.

	Number of Wild Oat Seedlings	
	per acre	per sq. yd
1954 after 3 years in ley	38,000	7·9
1955 after 4 years in ley	11,000	2·3
1956 after 5 years in ley	8,000	1·7
1957 after 6 years in ley	270	0·05
1958 after 7 years in ley	136	0·028
1959 after 8 years in ley	10	0·0002
1960 after 9 years in ley	0	0

No more graphic illustration could be given to show the stubbornness of this troublesome weed.

COUPLINGS FOR BULK HANDLING OF ANIMAL FEEDINGSTUFFS AND GRAIN

British Standard 3362:1961 gives details of a coupling for delivering animal feeding-stuffs or grain from bulk vehicles to farm bins.

The coupling is for a hose with a nominal bore of 4 inches, designed for pneumatic conveying at 5-25 tons/hour at an air pressure of up to 30 lb/in. A screwed coupling with a thread of round form to B.S.336 has been adopted, since this is the type in current use. A spigot-and-socket coupling is, however, specified in an Appendix, because it is thought that this type may provide a satisfactory alternative.

Copies of British Standard 3362:1961 are obtainable from British Standards Institution, British Standards House, 2 Park Street, London, W.1., price 4*s*.

BEEF RECORDING OF LINCOLN REDS

Following the article *How Big are our Beef Breeds* by Dr. I. L. Mason, in the May issue of this *Journal*, the Lincoln Red Cattle Society has drawn our attention to their interim report on independently observed weighings of Lincoln Reds. From 619 weighings of animals under 540 days old, covering twelve herds, the following figures are published:

64 weighings of bulls returned an average age of 337 days with an average daily liveweight gain of 2·79 lb

232 weighings of steers returned an average age of 364 days with an average daily liveweight gain of 2·05 lb

323 weighings of heifers returned an average age of 364 days with an average daily liveweight gain of 1·90 lb.

Some herds were engaged in early beef production, others were interested in getting animals ready as stores only, while in other herds the emphasis was on the rearing of bulls. The majority of the heifers weighed were being retained for breeding purposes, so they were not on a high plane of nutrition, which is reflected particularly in the L.W.G. of the older animals where the heifers would be in reasonable store condition appropriate for going to the bull. These figures show the ability of the Lincoln Red to produce a good carcass at a young age. Since some animals *lost* weight between the first and second weighings, and these losses were allowed for in the averages, the summary also gives a fair picture of the breed's potential.

Eight young Lincoln Red/Dairy Crosses which were weighed had an average age of 276 days and an average daily liveweight gain of 2·38 lb, the crosses including Ayrshires, Guernseys and Friesians.

The first of the British Breed Societies to put into operation an independently observed Recording Scheme, the Lincoln Red Cattle Society, is making plans now to expand its activities in this direction later this year, so as to bring more herds into the Scheme.

CATTLE MOVEMENTS: CHANGE IN RECORD REQUIREMENTS

The regulations requiring detailed records of *cattle movements* to be kept were relaxed from August 9th. From that date only a simple record of the number of animals involved is required for cattle moved direct to a slaughterhouse, fatstock market or certification centre. The record of all other movements of cattle must continue to include details of the breed, age, sex and ear-mark of each animal moved. The form in which the movements record is kept has also been slightly amended. Existing forms can be amended in manuscript.

Slaughterhouse operators have been specifically exempted from the requirements of the Movement of Animals (Records) Order, 1960, as regards animals in which they have no interest, save to provide slaughtering facilities; the other persons moving the animals to the slaughterhouse are responsible for recording the movements. A slaughterhouse proprietor whose interest in animals sent to a slaughterhouse extends beyond their slaughter, e.g., a butcher operating a slaughterhouse who moves his own animals to it for slaughter, must continue to keep movement records.

At present, owners of herds registered under the Tuberculosis (Attested Herds) Scheme are obliged by its rules to keep a herd register. Now they need no longer keep such a register in addition to a record of movements required in accordance with the Movement of Animals (Records) Order. The latter record will be accepted for the purposes of the Attested Herds Scheme.

EFFLUENT AND WATER TREATMENT

The Second Effluent and Water Treatment Exhibition and Convention will be held at the Seymour Hall, London, from 31st October until 3rd November. There will be a number of developments and innovations on show and papers will be presented covering internationally the subjects of effluent and water treatment by well-known authors.

Increasingly severe restrictions are being imposed by River Authorities on the type of effluent discharged. The growing volume of water required for industry cannot always be provided economically from available sources and recovery of used water is of prime importance. Both the subjects are well represented at the Exhibition by new designs and techniques. Special attention is being given to the anti-corrosive internal treatment of pipework and to the use of plastic and resin/glass laminate equipment for combating corrosion. Filtration equipment is becoming more and more important, including mechanically cleaned bar screens, grit collectors and washers, and conveyor type and circular sludge collectors.

Book Reviews

Agricultural Engineers Handbook. C. B. Ritchey, P. Jacobson and C. W. Hall. McGraw-Hill. 151*s*.

During the past few years many books have been written on agricultural machinery, but very few on agricultural engineering. This is to be expected, because users of the machinery are more numerous than designers and mechanization experts.

This newly published American volume comes squarely into the category of engineering, and contains a vast amount of fundamental information. It has been compiled by a large number of specialists—research workers and advisory officers—most of whom are well-known in Britain. Their contributions have been edited by a central authority and, as the editors point out, this has maintained conciseness and clarity and an analytical approach. It has, perhaps, also tended to give a hint of monotony which might have been absent if the 41 contributors had published their sections independently, but in a reference book this matters little.

The first chapter is headed "Economics of Farm Machinery", a title which would never have appeared in a book on engineering some years ago. This is a reminder that the view of research workers and advisory officers has widened. They used to be concerned only with whether a machine will work well, but now they are concerned also with whether the machine will fit into the general plan of the farm. The chapter has tables of man-hours and equipment needed for various enterprises, and gives methods of calculating crop production costs.

In studying the chapter on the Design of Field Machinery, the British reader realizes how close American and British engineering are coming together, and he finds that the chapters on Power Transmission Elements, Wheels and Tyres, Power Controls for Implements, Sprayers, Dusters, Balers and Combines are all as relevant in Britain as in the U.S.A. Only a very few chapters, such as those on Cotton-Harvesting Machines and Wind Erosion Control, are inapplicable to Britain. Farm machinery is becoming international and has moved far since the days when small districts, and even villages, had their own special design of plough. We now use many harvesting implements of American design in Britain, and fortunately for the prosperity of our export trade, the U.S.A. uses many British tractors and cultivators. This book proves that some of the literature also can be international.

The chapters on Drying Farm Crops and the Storage of Farm Crops tell of developments which are interesting to compare with our own progress in these subjects. The section on fruit and vegetable handling has special lessons for Britain because the experience of market gardening to supply distant city markets has been more intense in the U.S.A. than here.

The book is well indexed, and this is important to a volume which will be used more as a reference book than as one to be read through from cover to cover.

H.J.H.

Fishery Management. R. S. Fort and J. D. Brayshaw. Faber and Faber. 45*s*.

The management of freshwater fisheries in Britain so as to yield the maximum production of sizeable fish is considered in this book in relation to the other, sometimes conflicting, needs of river management. The book concentrates upon game fish in rivers, but there are many pertinent references to coarse fisheries and to enclosed waters.

After introducing the reader to river ecology and the identification of fish, the authors consider practical methods of controlling fish stocks, paying particular attention to the construction and running of hatcheries and the use of traps. The design of fish passes and netting techniques, the latter much neglected by authors of the past, rightly occupies a chapter on its own. Careful and often detailed consideration is also given to improvement by means of dams, weed control and the provision of access paths, bridges and fishing shelters. There are excellent chapters on fishery administration and fishery law, which in common with other parts of the book incorporate interesting historical sections, and clarify the distinction to be made between the statutory conservation duties of River Boards and the responsibilities of riparian owners. With such a wealth of information and ideas, much of it original, it is indeed disappointing that the authors

did not bring their general conclusions together in a final chapter.

The text is well illustrated with 17 plates and numerous very high quality line drawings. There is a good index and a short bibliography, but publication dates are unfortunately omitted. Supplementary references are given in the text and in footnotes, though they are generally insufficient to distinguish the authors' experiences and opinions from those of other authorities. This is especially regrettable where errors occur, though considering the length of the book these are remarkably few. Some should, however, be pointed out: in connection with the solution of gases in water, the importance of surface aeration in supplying streams with dissolved oxygen is generally under-estimated. On page 20 oxygen is said to be more soluble than carbon dioxide, whereas the reverse is true. In pages 33 and 316 two conflicting values of the concentration of dissolved oxygen in air saturated water are quoted; while on page 60 the cathode (instead of the anode) is said to attract fish when electric fishing with direct current.

Nevertheless, despite these criticisms of detail, the book should be read by all whose work and recreation bring them close to fisheries. Filled with valuable information and stimulating ideas, it will promote a greater understanding of the purposes, problems and procedures of effective fishery management.

J.S.A.

European Agriculture in 1965. FAO. H.M. Stationery Office, London. 14*s*. (15*s*. 2*d*. by post.)

This is an interesting account of the present condition of European agriculture, and its probable position five years ahead. It enables us to see where our own agriculture is, compared with others on the continent. In this respect the opening paragraph is particularly interesting. It reads "Nowhere in Europe is agriculture being left to the vagaries of nature or the market. Government intervention in the agricultural sector has become common to all European countries. Thus all governments have developed agricultural policies whose aim is to assure a productive and prosperous national agriculture in the interests of the nation as a whole".

The word "European" is fortunately given a wide meaning. It includes Russia and her colonies and also the United Kingdom and the Republic of Ireland. In addition to reports and figures for individual countries there are also regional accounts for Eastern Europe (excluding Russia), Western Europe, the Common Market countries and "other countries". The work is divided into four parts, namely, Introduction (and Production), Demand for Food, Outlook for 1965, and Problems Ahead.

It is interesting to note that production has been increasing in all regions at about the same rate, 2·8 per cent a year, except in Russia where the rate of increase is considerably greater, but then Russia started from a much lower point.

The publication's forecasts for 1965 have been made on the assumption that the national income will increase by 33, 39 and 47 per cent. In all three cases this would mean that in the low-income countries calorie intake per head would increase by only 5 per cent while in the high-income ones it would remain stable or decline, but that quality produce would be more in demand. Taking population increase into account, the total demand at the farm gate is expected to rise from 15 to 18 per cent. In Western Europe farm costs are expected to rise faster than income, and the labour force is likely to decline in consequence.

Bearing in mind the impact of the Common Market, this report is a very valuable document for anyone concerned with the future of European agriculture.

G.O.

The Daffodil and Tulip Year Book 1961. The Royal Horticultural Society. 12*s*. 6*d*.

This, the 26th volume of the *Daffodil and Tulip Year Book* to be published, is dedicated to Mr. Alex Gray, who has specialized for many years in the raising and growing of miniature daffodils and helped make these small treasures so popular.

As usual in a publication of this kind there is a wide range of chapters by many well-known growers of daffodils and tulips. For those who are keen on showing, much useful information can be obtained from an article on the staging of daffodils for exhibition, by Mr. John Lee.

Another contribution which should be of particular interest to readers is by H. F. du Pont, who describes in detail his

experiences in naturalizing daffodils on his estate in Delaware, U.S.A. He tells us how to plan, plant and maintain them and gives a valuable selection of varieties to choose from. Particular stress is laid on the older varieties which have stood the test of time for this type of planting.

Mr. M. Jefferson-Brown discusses some of the small attractive autumn flowering species and other daffodils which have been outstanding with him during the season.

There are some very noteworthy comments by J. M. de Naevarro on the breeding of sun-proof red and white daffodils, but it seems that there are still very few which do not burn in the sun unless given protection. D. Van Konynenburg describes the forcing of tulips and daffodils in Lincolnshire, and quotes figures of the enormous number of bulbs which are being grown for the cut flower market.

I was most interested in the chapter dealing with the history and breeding of tulips since they were first introduced into Holland some 400 years ago. Mr. Degenaar de Jager also describes the development of the various types over the years and names some of the very earliest varieties which have given rise to the modern types.

Finally there is a very important section devoted to some of the pests and diseases which attack daffodils and tulips; this gives modern methods of control. Although written by specialists who have made this a particular study, it is worded in a manner which can be clearly understood.

G.H.P.

Animal Husbandry. R. D. Park. Oxford University Press. 18*s*.

Simple physiology, common ailments and diseases, food and feeding, good management of cattle, sheep and pigs are all covered in some 240 pages. As Sir William Slater states in his foreword: "To write a book providing this basic knowledge in a simple, clear and readable form, is a difficult task", but the author has succeeded with distinction.

The first section, dealing with physiology and diseases, is presented in a simple straightforward way. There is a weakness, in my opinion, in the feeding section, where so much emphasis has been put on the hay equivalent system of evaluating foods. This may make description simple but, as hay is such a variable commodity, it is anything but scientific. The rearing of beef is dealt with rather sketchily. For instance, the young reader is told that to get stock fit for the butcher at 20 months "fairly liberal feeding must be given". More precise information is needed. Sufficient attention does not seem to have been given to the appetite requirement of the cattle.

The section on sheep is a highlight of the book, and could profitably be read by many farmers and shepherds.

The pig chapter tackles housing, feeding and management in a most competent way. The Ministry Livestock Officer will, however, be satisfied to put the crown in only one of the boar's ears at the time of licensing.

There has long been a call for this type of book for the young farmer seeking the simple facts of agricultural science. This book, which is primarily intended for the student attending farm institutes, can give him the start he requires. It is easy to read, very well illustrated by photographs and drawings and excellently bound.

W.L.

The Grass Crop. (2nd Edition). William Davies. Spon. 45*s*.

The second edition of Dr. Davies's highly successful book includes two new chapters, "Farming Systems" and "Extending the Grazing Season". Much of the text has been revised to include more recent developments in grassland research.

Embodying, as it does, the life-work and philosophy of an acknowledged authority on grass, Dr. Davies's experience has enabled him to adopt a world-wide approach. He was one of the first to regard the pasture sward in terms of dynamic ecology, and this concept permeates the book, both in its theoretical and practical implications. The author's arguments are well documented and his conclusions are derived from objective analyses of all the facts available to him.

Dr. Davies fully appreciates the importance of improved varieties and their exploitation by proper management. He rightly states that "in spite of undoubted progress in grassland technology during the past half century, it is extremely important that it should be known generally that pasture lands are comparatively ill farmed in comparison with other crops".

The serious student will find many references to important problems in grassland research which need to be investigated. For example, the stimulating reference to the value of both clover and applied nitrogen should encourage the breeder to consider how far the antagonism between these two can be resolved. Thus it may well be possible to produce varieties of clover which are effective at higher levels of applied nitrogen, just as the fermentation microbiologist has been able to produce varieties of yeast which will tolerate high concentrations of alcohol.

In his own work, and in this very readable and stimulating book, Dr. Davies has made a notable contribution towards the "growing consciousness of the national importance of the grass crop". Those who are concerned with the future of agriculture will be particularly indebted to him.

P.T.T.

Anatomy of Seed Plants. KATHERINE ESAU. Chapman and Hall. 56*s*.

The study of plant anatomy has a fascination of its own, but in these days it is an advantage if the subject also has practical applications. Without a detailed knowledge of the anatomy of the plant, it is clear that not only would our understanding of such a subject as plant pathology rest on poor foundations, but that advances in it would be uncertain and slow.

Good books on plant anatomy are few, so that this is a most welcome addition to the number. Those familiar with Prof. Esau's book *Plant Anatomy* will naturally expect an authoritative and clear treatment of the subject. In this they will not be disappointed. The *Anatomy of Seed Plants*, though considerably shorter than the earlier work, contains a wealth of detailed information and is well illustrated with line drawings, photomicrographs and some electron micrographs of outstandingly high quality.

The plan of the book follows the orthodox pattern, cells and tissues being considered first and then the different plant parts. Each chapter ends with a selected list of references, and a glossary of terms used in plant anatomy is given at the end of the book. This is useful, though one may not always agree with the definitions given—thus gluten is defined as amorphous protein occurring in the starchy endosperm of cereals. This is certainly wrong as "gluten" cannot in any sense of the term be said to occur except in wheat. It is moreover debatable to say that gluten as such occurs in the grain. Again, anthesis is defined as "full expansion of the flower or time when fertilization occurs". Surely pollination would be better than fertilization. These, however, are minor points in a book of undoubted excellence, which should give the student a firm foundation on which to base his botanical studies.

G.P.C.

The Entry of Fission Products into Food Chains. Edited by J. F. Loutit and R. Scott Russell (Volume 3 of Progress in Nuclear Energy Series VI). Pergamon Press. 45*s*.

The possible radiation hazard to the human race from the ingestion of man-made radioactive materials in peace-time is the subject of regular reports, but this book is different in that it gives some answers to this hazard in the event of a nuclear weapon attack. The reader should bear in mind, however, that the section which deals with results from weapon trials relates to the conditions obtaining from the explosion of bombs of the kiloton size over Australia; it follows that some differences could be expected in the event of a megaton bomb exploded over Britain.

But the book does deal with some of the fundamental problems common to any type of nuclear weapon attack, such as the composition of fall-out, its solubility in water and transfer from the gastro-intestinal tract to the bloodstream of animals, the percentage retention by plants of agricultural importance and the extent to which the various fission products might be transferred to human food, either directly from plants or indirectly through the soil-plant-animal chain.

An important fact emerges that in the case of contamination arising from nuclear weapon testing, as with discharges of radioactive materials from atomic energy plants, the greatest hazard to humans arises from animal products such as milk, rather than from food prepared directly from contaminated plants, such as bread.

It will be noted that all the fission products passing through the gastro-intestinal tract, whether of humans or animals, could cause considerable damage; but of those which pass into the bloodstream, radioiodine and radiostrontium will cause the greatest harm. It can also be expected that

animals are likely to suffer first through damage to the gastro-intestinal tract, followed by damage to the thyroid from radioiodine, and in the long term through radiostrontium deposited in the skeleton.

The section of the book dealing with the laboratory tests on the metabolism of fission products by farm animals provides valuable data which will apply in any type of nuclear attack. From a known ground concentration it can be deduced what concentration to expect of various radioisotopes most likely to be found in food.

The book provides the sort of information which is most valuable to those who plan our defences. Any reader who has this aspect in mind will find it extremely valuable, bearing in mind the limitations I have outlined in the opening paragraph.

G.W.

Gwyddor Gwlad. Edited by T. IFOR REES. University of Wales Press. 2*s*. 6*d*.

This attractively produced booklet contains contributions by two eminent Welshmen. Dr. T. J. Jenkin in his article "Y Cae Yd" (The Corn Field) writes of his earlier life, from 1885 to the time (1909) when he left the family farm to start his career as an agricultural scientist. It is a chronicle, written in immaculate Welsh, of crop husbandry techniques on a Pembrokeshire farm. One senses that the writer examines these practices through the medium of his later acquired scientific discipline and that the old methods stand up well to the analysis.

He describes in some detail the "swing" (wheelless) plough, and stresses the importance attached to good ploughing as the key factor in seedbed preparation. This strikes with some force at the present time, when ploughing standards are admittedly on the decline. A good account of rotations, manuring and seedbed preparation is given. The section on corn harvesting techniques is particularly interesting and there is a full description, together with photographs, of the old type scythe with a wooden attachment to facilitate cutting a neat swathe. The overall impression in this fascinating article is that of considerable attention to detail in order to obtain good crop yields.

In the first of his two articles, Dr. Rees discusses "Y Twrci" (The Turkey), tracing the derivation of the names given to this bird in various European countries and finally presenting recent statistics to indicate its importance in Great Britain.

Finally "Y Felin Ddwr" (The Water Mill) is introduced by a Welsh poem of nostalgic lament to a mill that has ceased to function. There is an interesting historical account of milling by water power from Roman times to the middle ages. The completion of this article awaits the next issue of this periodical which the editor hopes will now be published annually.

G.M.D.

Correction

New Housing for Dairy Cows in the East Midlands, Nottingham University. The authors of this Survey, reviewed in our May issue (p.113), were Mr. Peter Manning and Mr. K. A. Ingersent.

Printed in England under the authority of HER MAJESTY'S STATIONERY OFFICE by Hull Printers Limited, Willerby, Hull, Yorks.

(K77) 72-1-61-10.

OFFICIAL APPOINTMENTS

THE GOVERNMENT OF NORTHERN NIGERIA

requires

SENIOR AGRICULTURAL ENGINEER

on favourable contract terms

Qualifications: B.Sc. Agricultural Engineering involving a four-year course in general agricultural engineering; or

A.M.I.Mech.E. with agricultural experience; or

A.M.I.C.E. with mechanical bias including agricultural experience.

Candidate should have appropriate experience of agricultural machinery and equipment, and practical experience in Soil Conservation work would be desirable. Candidates should preferably be between 35-45 years of age.

Duties: The duties are of a general nature pertaining to Land Use and development and the holder must have a wide knowledge of Agricultural Implements and Machinery, Survey, Soil Conservation and building. He may be employed on Soil Conservation projects or the erection and maintenance of machinery and buildings on Agricultural Stations or projects.

Emoluments: 1. *Salary:* According to qualifications and experience in the range of £1944-£2568 gross per annum.

2. *Outfit Allowance* of £45, if the basic salary does not exceed £1747 per annum, and Touring Equipment Allowance of £40 on first appointment.

3. *Resettlement Gratuity* of £37 10*s.* 0*d.* for each three months' service, inclusive of earned leave, payable on satisfactory completion of contract.

4. *Children's Allowance:* £120 for one child, £216 for two and £288 for three children eligible up to the age of eighteen years.

5. *Free passages* for officer and wife on appointment and on leave and assistance towards cost of children's passages.

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Applicants should write to:

The Recruitment Secretary (Overseas), Northern Region Recruiting Agency, Nigeria House, 9 Northumberland Avenue. London, W.C.2.

or telephone TRAfalgar 1244, Extension 145.

UNIVERSITY OF NEW ENGLAND
Armidale, New South Wales

LECTURER OR SENIOR LECTURER IN PHYSIOLOGY

Applications are invited for the abovementioned position. The Department of Physiology, which is at present expanding offers courses in two faculties and within the Faculty of Science teaches to honours and postgraduate level.

An applicant with general or specific training in Physiology and qualifications in either Science, Veterinary Science, Medicine or Agricultural Science will be considered for the position. The Department is however particularly interested in developing its courses in general and comparative mammalian physiology and the biophysical aspects of physiology.

The successful applicant will be expected to assist in the teaching of second and third year students in the Faculty of Science and to continue his own line of research or to join one of the research projects already in progress.

Salary for a Lecturer is within the range £A1730 × 105—£A2435 and for a Senior Lecturer £A2550 × 100—£A3000 p.a. In addition cost of living adjustments at present amount to £A49. The salary for overseas applicants commences from the date of embarkation and fares of applicant and family are paid together with a removal allowance of £A300. The commencing salary will be fixed according to qualifications and experience.

The position is superannuable and up to 90% of the purchase price of a house may be advanced through the University housing scheme.

Further information and the conditions of appointment may be obtained from the Secretary, Association of Universities of the British Commonwealth (Branch Office), Marlborough House, Pall Mall, London, S.W.1.

Applications close, in Australia and London, on 30*th November*, 1961.

UNIVERSITY OF NEW ENGLAND
Armidale, New South Wales

SENIOR LABORATORY TECHNICIAN—LABORATORY TECHNICIAN

Applications are invited for the abovementioned position in the Department of Agronomy in the Faculty of Rural Science.

One position is available and duties will include either (a) assisting with the laboratory work of the Department and attending experimental plants growing under controlled environmental conditions, or (b) assisting with field and glasshouse experiments with pastures and crops, depending on the appointment made.

The commencing wage will be fixed according to qualifications and experience up to £A26 13*s.* 6*d.* per week for males and £A22 15*s.* for females for Laboratory Technicians, and up to £A30 10*s.* 5*d.* per week for Senior Laboratory Technicians. Four weeks annual leave; liberal sick leave and long service leave. Fares will be paid and removal expenses up to £A200.

In-service training may be undertaken towards a diploma in Science Technology.

Applications from within Australia and New Zealand should be forwarded to reach the undersigned* not later than 30*th November*, 1961, while overseas applicants should forward their applications to the Secretary, Association of Universities of the British Commonwealth, Marlborough House, Pall Mall, London, S.W.1 by the same date. In the case of overseas applicants an additional copy should be forwarded direct to the undersigned* Applications should give full particulars of qualifications and experience, together with the names of two referees.

**K. R. Long, Acting Registrar*, University of New England, Armidale, N.S.W., Australia.

OFFICIAL APPOINTMENTS (*cont.*)

UNIVERSITY OF NEW ENGLAND

Armidale, New South Wales

LECTURER/SENIOR LECTURER IN AGRONOMY

Applications are invited for the abovementioned position in the Faculty of Rural Science. The successful applicant will be a graduate with an appropriate degree and with postgraduate research and/or field experience in Agronomy. The appointee will be required to give lectures in general agronomy, fodder conservation and cropping, supervise projects by advanced students and to conduct research for which excellent facilities are available in plant Physiology, Soil Science and Agronomy. Commencing salary will be fixed according to qualifications and experience within the range of £A1730 × 105—£A2435 for a Lecturer, and £A2550 × 95—£A3000 for a Senior Lecturer plus a cost of living allowance at present amounting to £A49 per annum. Provision is made for superannuation, travel and removal expenses and assistance in buying or building a house.

A residential college fellowship may be awarded to a single person.

Further information and the conditions of appointment may be obtained from the Secretary, Association of Universities of the British Commonwealth (Branch Office), Marlborough House, Pall Mall, London, S.W.1.

Applications close, in Australia and London, on *30th November*, 1961.

Please mention AGRICULTURE *when corresponding with Advertisers*

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